Transient velocity changes beneath Great Sitkin Volcano in central Aleutian volcanic arc prior to and during the 2021-present eruption

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Volcanic eruptions are destructive and potentially disastrous. Understanding magmatic behavior beneath volcanoes is vital for understanding eruptions and, eventually, predicting when eruptions may occur. The 2021-present eruption at Great Sitkin Volcano in central Aleutian volcanic arc is an opportunity to study subsurface seismic velocity changes (dv/v) with the evolution of the magmatic system, using ambient noise interferometry (ANI). Single-station ANI is a useful tool for remote locations with limited instruments such as Great Sitkin Volcano, which began erupting at 05:04 UTC on May 26, 2021. Using data from four 3-component broadband seismometers deployed around the volcano, single-station ANI allows for subsurface velocity analysis with 3 same-component (SC) and 6 cross-component (XC) correlations. We measure the changes in seismic velocities from July 2019 to April 2022 in 4 frequency bands ranging between 0.1-3.0 Hz using the trace stretching method. We characterize the variations with respect to the different stages and key events of the eruption cycle. We observe a significant velocity increase beginning in August 2021 (following the formation of the lava dome) for all stations, with the largest dv/v at station AV.GSSP to the northwest of the caldera. We suggest that the increase in seismic velocity during the lava dome growth could be an effect of magma extrusion. Removal of magma from the reservoir would generally result in a bulk increase of seismic velocities. In addition, the extrusion of magma may lead to the deflation of a volcano and the closure of cracks in the subsurface (formed from increased pressurization due to a recharging magma chamber), which would also contribute to an increase in seismic velocities. Further analysis of these observations will help us understand how volcanoes behave throughout the eruption cycle, which is important for forecasting and monitoring future volcanic eruptions and for understanding volcanism and the development of volcanic eruptions in general.

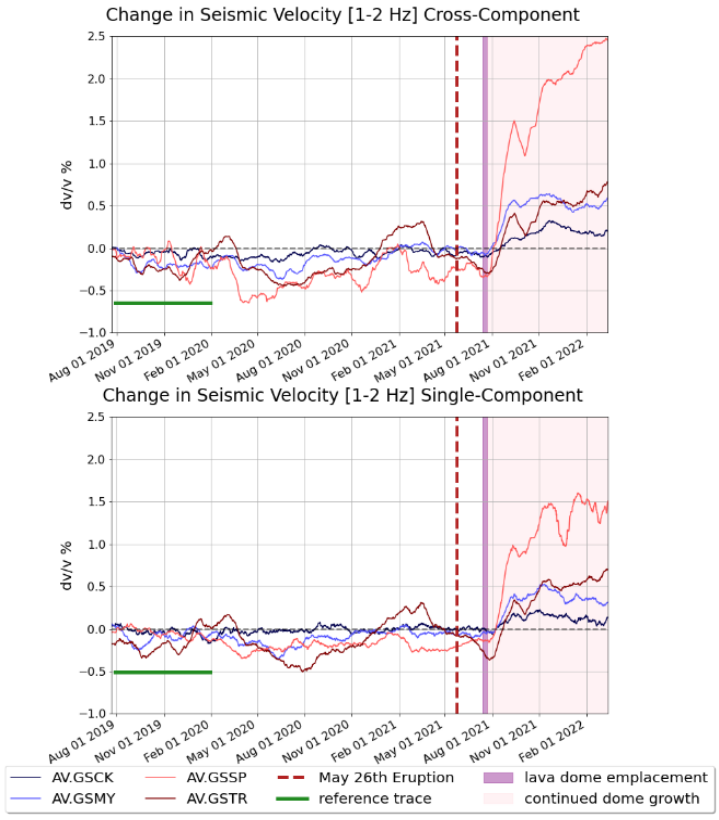

Figure 1. Variation of seismic velocities at the four stations around Great Sitkin Volcano. Same-component and cross-component results are shown above. The vertical lines represent the volcanic eruption (dashed red) and the lava dome emplacement (light purple), while the shaded regions represents the continuing lava dome growth (light pink).