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A Geochemical Approach to Unravelling the Magmatic Web beneath Hawai‘i

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In 2022 the Hawaiian volcanoes Kīlauea and Mauna Loa erupted simultaneously, a rare occasion that has not occurred during the historical period (1843-present). The resulting real-time geophysical and geochemical datasets have provided unprecedented insight into the potential interconnectedness of these volcanoes. It has been hypothesized that neighboring active volcanoes may: 1) experience an increase or decrease of pressure within one volcanic edifice and/or plumbing system due to the eruption or injection of magma at the other volcano, 2) tectonically influence one another as the mass of either volcano causes the Pacific Plate to sink, or 3) share plumbing systems, or parts thereof, with mixing of magma batches at either mantle or crustal levels.

The 2018 Kīlauea eruption significantly drained both the Summit and East Rift Zone magma storage areas. Since this massive outpouring of lava, erupted lavas in Kīlauea caldera contain some high forsterite olivine. This may indicate the arrival of a fresh batch of deeply sourced magma during the same period when Mauna Loa exhibited signs of seismic and deformational unrest, signaling an arrival of magma. Comparing concurrent new magmas at both Kīlauea and Mauna Loa provides the opportunity to geochemically test the potential interconnectedness of the two volcanoes' plumbing systems. This is accomplished here using element and Pb-Hf-Nd-Sr isotopic compositions of Kīlauea lavas erupted 2020-2023 that bracket samples from the 2022 Mauna Loa eruption.

We have found a systematic shift in Kīlauea's trace element and isotopic compositions before and after the 2022 Mauna Loa eruption. This change in compositions includes Sr/K and Th/Nb, along with SiO_2, CaO, Al_2O_3, K_2O, and TiO_2 that have been normalized to 16 wt% MgO, and with variations in Pb and Sr isotopic compositions. Modelling of this data is in progress to assess the mechanism by which the Mauna Loa and Kīlauea systems may interact, how much they interacted from 2020-2022, and at what level they interact – that is, whether they are sampling a similar mantle source or commingling magma within the crustal plumbing system, as has been suggested by recent seismic catalogues.