The ocean's response to the 2018 Kīlauea Volcano eruption

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The 2018 eruption of Kīlauea Volcano on the island of Hawai'i injected millions of cubic meters of molten lava into the nutrient poor waters of North Pacific Subtropical Gyre. The lava-impacted seawater was characterized by high concentrations of metals and nutrients that stimulated phytoplankton growth and created an intense band of chlorophyll that extended 150 km offshore. Chemical and genomic evidence collected during a rapid response oceanographic expedition revealed that this diatom-dominated bloom was fueled by two linked sources of nutrients: (1) dissolution of basalt which contributed silicate, phosphate and iron and (2) upwelling of lava-warmed, deep seawater which also contributed phosphate and silicate, and crucially was the sole source of nitrate. Post-expedition laboratory lava experiments confirmed that the increase in water-column phosphate concentrations was mitigated by strong adsorption onto abundant iron oxyhydroxides that precipitated when lava-derived Fe(II) oxidized within the water column. The buoyant heating of cold, nutrient-rich deep waters was supported by by remotely-operated vehicle observations of submarine lava flows at water-column depths of 725 m. The marine ecosystem response to such a substantial addition of nutrients is rarely sampled in real time and the July 2018 expedition provided a unique opportunity to observe first-hand the effect on the open ocean ecosystem.