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Geochemical and rheological characterization of the 1823 CE Keaīwa lava flow erupted from the Great Crack at Kīlauea Volcano

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Recent volcanism at Kīlauea typically involves effusive, non-life-threatening eruptions. However, the ~1500–1820 CE Keanakāko'i Tephra and older units show that Kīlauea experiences periods of dominantly explosive activity at the summit. Whether and how the East and Southwest Rift Zones (ERZ and SWRZ) are affected by explosive cycles is not well known. Here, we examine field, rheological, and petrological characteristics of the 1823 CE Keaīwa lava from the SWRZ. Eyewitness accounts from native Hawaiians described the 1823 CE eruption as “a period of sudden and violent lava inundation”. This primarily subaerial flow covers ~12 km^2 on the southwest slope of Kīlauea. Field investigations reveal that this lava is unusual compared to other Kīlauea lava flows in several ways. (1) The flow issued from the 9-km long fissure known as the Great Crack, one of the largest recent subaerial eruptive structures on Earth, which also marks the termination of the SWRZ. New fieldwork suggests that this 50 m-wide by 50 m-deep feature likely formed syn-eruptively. (2) There is little to no pyroclastic material, tephra cones, or spatter ramparts around this fissure. (3) The flow has a thin sheet-like morphology, <10 cm in many proximal areas, which suggests low viscosity and/or high effusion rates. (4) There are ramp-up structures on older tumuli and on the flanks of several cones (Lava Plastered Cones), supporting high flow velocities. Ongoing work on glass, mineral, and bulk-rock analyses allows us to better constrain petrogenetic linkages between the Keaīwa flow and other summit and rift zone eruptions from the same period at the end of the last explosive cycle, along with understanding the origin of the unusual eruption style and rheological behavior. Glass analyses yield homogeneous compositions (6.4±0.1 wt.% MgO) across the majority of the fissure, giving eruption temperatures of 1152±5°C. Neither composition nor temperature are significantly different from other Kīlauea eruptions, indicating that the unusually large spread of thin, modest volume lava was not associated with unusual magmatic conditions but instead related to sudden, high effusion rates.