

From Kīlauea or Mauna Loa? Geochemistry of Holocene Tephra Deposits on the Southeast Flank of Mauna Loa Volcano (Hawai'i)

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Tephra deposits are widespread across the Island of Hawai'i, many of which remain poorly studied. An understanding of the ages and sources of these tephtras is important for assessing the frequency of explosive eruptions and thus the hazard potential for individual volcanoes on the island.

For this study, we investigated a two-meter-thick section of tephra located midway up the southeast flank of Mauna Loa. We identified 35 tephra layers and obtained 13 radiocarbon dates that constrain the eruptive activity of these tephtras to between 4590±40 BCE and 1570±50 CE [1]. We also obtained bulk ash EDXRF data and EPMA glass compositions to evaluate the source of the tephtras based on Loa- and Kea-trend geochemical discriminants.

Although work is ongoing, initial data suggest that many of the layers are sourced from Kīlauea, and three tephra layers have solid correlations with known sources.

A tephra layer near the top of the section has Kea-trend geochemistry based on incompatible trace elements, suggesting it was sourced from Kīlauea. The layer overlies others dated at 1460±25 and 1570±50 CE and is likely part of the Keanakāko'i Tephra (1500–early 1820's CE [2]).

A layer from the middle of the section has glass compositions with anomalously high K₂O and TiO₂ concentrations (0.7 and 3.1 wt%, respectively) at a given MgO content. These compositions mirror those of the Kulanaokuaiki Tephra Unit 2 from Kīlauea (440–640 CE) [3]. Radiocarbon dates place this layer between 40±30 and 1570±50 CE, confirming a potential Kulanaokuaiki Unit 2 correlation.

A layer from the lower part of the middle section, constrained by radiocarbon dates between 2580±30 and 230±30 BCE, has glass geochemistry suggestive of the Loa-trend (lower CaO, TiO₂; higher SiO₂, Na₂O/TiO₂ contents at the same MgO content as Kea-trend products). This tephra is interpreted to have erupted from Mauna Loa. The presence of a Mauna Loa-sourced tephra on the southeast flank of Mauna Loa suggests that the volcano may have an under-appreciated history of large explosive eruptions.

[1] Trusdell et al. (2020) Goldschmidt Abstract.

[2] Swanson and Houghton (2018) GSA Sp Paper, 538.

[3] Fiske et al. (2009) GSA Bulletin, 121.