The Pāhala sill complex and deep magma transport at Hawai`i

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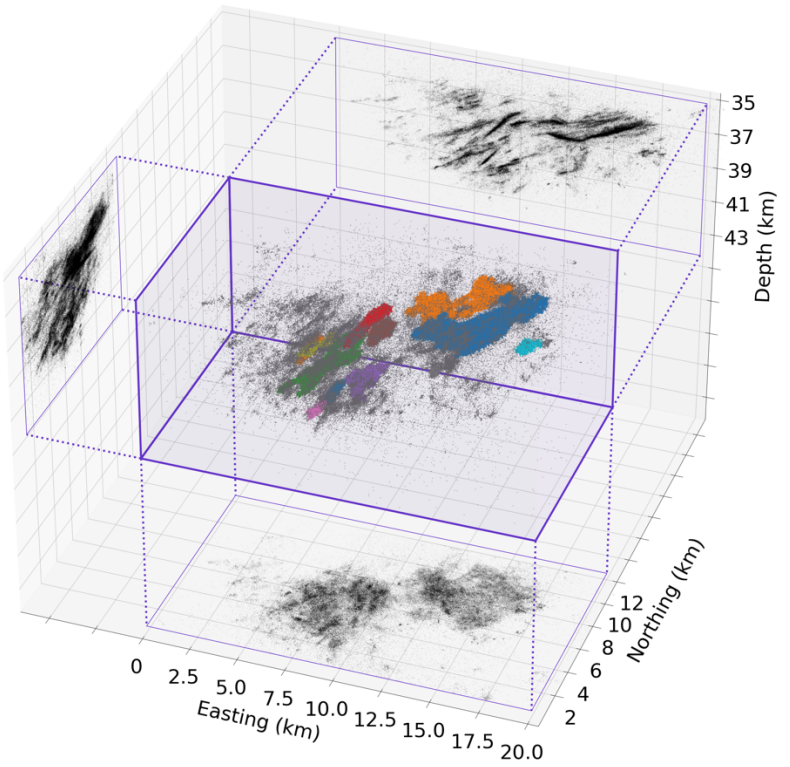
Significant unrest at Kīlauea and Mauna Loa volcanoes over the last five years has highlighted the importance of understanding eruptive potential and dynamics on Hawai`i. While the near-surface part of the magma system is conceptually well-understood, the architecture of the deeper system is largely speculative; consequently, a holistic understanding of magma transport and supply processes has remained out of reach. Key topics include possible mechanisms for physical and chemical interaction between Kīlauea and Mauna Loa, and the deep structures and processes that enable mantle-driven magma supply surges. To address these questions, we construct and analyze a relocated earthquake catalog spanning late 2018 to 2022. We image a 15 km-long sill complex situated at 36-43 km depth, termed the Pāhala sill complex. We identify episodes of magma injection into the sills that are contemporaneous with eruptions at Kīlauea, suggesting the rapid, systemwide propagation of pressure gradients. Our catalog enables us to observe mantle magma dynamics in situ at high resolution. The sill complex is connected to the Kīlauea and Mauna Loa edifices via continuous bands of seismicity that may delineate magma transport pathways, suggesting that the sills could represent a common nexus of magma supply to the surface. This degree of interconnectivity would challenge the canonical model of physically distinct plumbing systems and provide a new framework for interpreting eruptive interaction between the volcanoes, as well as other neighboring volcanoes globally.



Isometric view of seismicity in the Pāhala sill complex. Individual sills are colored for clarity. Earthquakes are also shown projected into depth sections and map view.