Hawai‘i: A melting pot for learning how volcanoes work

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Geochemical studies of Hawaiian shield volcanoes have provided major insights into how volcanoes work, and the dynamics of mantle and crustal processes. Some notable discoveries during the last 50 years include the use of helium isotopes to reveal the primitive nature of the Hawaiian mantle source (e.g. Kurz, Craig, Nakamura?), the presence of bimodal compositional trends across the chain (e.g., Tatusmoto, Abouchami, Weis, Huang), and the extent of crustal processes such as magma mixing, contamination, and the short residence time of magmas in the crust (e.g., Wright, Garcia, Pietruszka, Lynn). However, debates continues on many diverse topics including the size of magma chambers (Pietruszka, Poland, Anderson), gas concentrations (e.g., Gerlach, Wallace, Edmonds, Anderson), and the mantle causes of lava compositional variation (relative contributions of source vs. process) and their impact on volcanic processes (especially for explosive eruptions; e.g., Pietruszka, Edmonds, Lynn). Hawai‘i is the ideal venue for gaining a better understanding of these and other issues given its high frequency of eruptions, easy and relatively safe access, rapid change in lava chemistry, and most importantly, the extensive knowledge of its previous eruptions. Despite this knowledge, much is still to be learned about how these and other volcanoes work. Forty years of research has taught me that every eruption has something new to teach us. The Kīlauea 2018 Leilani eruption is a superb example of an unexpected and complex eruption that presented an outstanding opportunity to better understand magma storage and intrusion into rift zones at Kīlauea. It is essential that we avoid becoming complacent in thinking that we understand the dynamic magmatic systems of active volcanoes. The Puu Oo eruption (1983-2018) was the most intensely monitored event but the geochemistry of its lavas continued to change teaching us new lessons about mantle source heterogeneity, melting processes, magma transport and crustal processes. Thus, it is essential that we continue to formulate new and more insightful questions, and to improve our abilities to detect and interpret the geochemical fingerprints that lavas provide for us. Additionally, the integration of geochemical perspectives with those from field and geophysical studies is essential to gain a fundamental understanding of volcanoes. Most importantly, we should expect and prepare for serendipity with each eruption. New insights will be revealed if we are prepared to witness them.