WHAT MAKES HAWAI'I A UNIQUE MANTLE PLUME?

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Hawai'i is the archetype of mantle plumes and characterized by a series of unique features: 1) it has the largest buoyancy flux and erupted volume of lavas; 2) contrary to predictions from plume models, the Hawai'i mantle plume (HMP) has become stronger with time, especially on the islands where the flux is ~10(20) times higher than at 49(81) Ma [1,2]; 3) along the archipelago, volcanoes are distributed in two sub-parallel geographical chains that are geochemically distinct; and 4) erupted lavas show systematic compositional variations through volcano growth stages and are largely dominated by tholeiitic shield compositions.

During the shield stage, most Hawaiian volcanoes present one geochemical signature, either Loa or Kea, best illustrated with $^{208}Pb^*/^{206}Pb^*$. Very few samples are an exception to this observation. Statistically, the volcanoes can be subdivided into six compositional groups organized in a pattern parallel to the sharp edge of the Pacific large low shear velocity province (LLSVP). Moving away from the anomalous deep mantle seismic zones, these groups show a systematic decrease towards the northeast in the contribution of Loa-enriched characteristics. The HMP periodically entrains large-scale heterogeneities that contribute to hotspot volcanism on a smaller timescale than previously considered. The increased resolution afforded by this analysis indicates that the heterogeneity of the deep mantle is not limited to anomalous seismic zones.

The presence of compositional asymmetry in Pacific hotspots has been linked to the presence of the LLSVP at the core mantle boundary [3]. Comparable observations have since been documented in the Atlantic Ocean along the Tristan-Gough hotspot track, above the African LLSVP. In Hawai'i, the Loa component appears slowly along the Northwest Hawaiian Ridge [4] and dominates on the archipelago. It could be responsible for the major increase in plume flux on the archipelago after 5 Ma and the unique characteristics of the Hawaiian mantle plume.

[1] Wessel (2016) *Geophys. J. Int.* 204, 932-847.
[2] Van Ark & Lin (2004) *J. Geophys. Res.* 109, B11401
[3] Weis *et al* (2011) *Nat. Geosci.* 4, 831-838.
[4] Harrison *et al* (2017) *EPSL* 463, 298-309.