A Perisphere/LLAMA Model for Hawaiian Volcanism

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Abstract

The association of Hawaiian-Emperor volcanism with a large-scale central Pacific anisotropy anomaly at ~150 km depth, can be explained by tapping of shallow melt sources in a perisphere/LLAMA model. It is suggested the central Pacific location of the present anisotropy anomaly can be linked to diabatic melting of phlogopite-garnet-pyroxenites generated in the hinterland of the Permian-Triassic Telkhinia arc system in the central Panthalassan basin. Perisphere enrichment occurred when melts from a subducting slab generated through percolation of fluids released from the breakdown of serpentinite, invaded the mantle wedge at approximately 150-200 km depth to form veins of pyroxenite. A north-south trending enriched region was created paralleling the arc system, which also inherited the thermal profile of the mantle wedge, and a solar-like noble gas isotopic composition from fluxing of fluids between IDP-bearing deep-sea sediments and ultramafic layers of the oceanic crust prior to subduction. After termination of subduction in the Triassic, the enriched perisphere began to thermally equilibrate with the asthenosphere, causing the phlogopite-garnet-pyroxenite assemblage to follow a horizontal trajectory in P,T space. As the P,T path crossed the solidi for volatile-bearing pyroxenite compositions, partial melting generated alkaline melts, followed by tholeiitic
compositions on exhaustion of phlogopite. The present central Pacific anisotropy anomaly is the current manifest of this shallow compositional anomaly, and has been tapped by fracturing of the Pacific plate by plate tectonic processes to produce the Hawaiian-Emperor chain over the last 80 million years.

Keywords: Hawaiian volcanism, perisphere, LLAMA, phlogopite-garnet-pyroxenite, noble gas subduction barrier, diabatic melting, Telkhinia, propagating fractures