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Past plate and mantle motion from new ages for the Hawaiian-Emperor Seamount Chain

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Estimates of the relative motion between the Hawaiian and Louisville hotspots have consequences for understanding the role and character of deep Pacific-mantle return flow. The relative motion between these primary hotspots can be inferred by comparing the age records for their seamount trails. Our new 40Ar/39Ar ages for 18 lavas from 10 seamounts along the Hawaiian-Emperor Seamount Chain (HESC) show that volcanism started in the sharp portion of the Hawaiian-Emperor Bend (HEB) at $\geq$47.5 Ma and continued for $\geq$5 Myr (O'Connor et al., 2013). The slope of the along-track distance from the currently active Hawaiian hotspot plotted versus age is remarkably linear between $\sim$57 and 25 Ma in the central $\sim$1900 km of the seamount chain, including the HEB. This model predicts an age for the oldest Emperor Seamounts that matches published ages, implying that a linear age-distance relationship might extend back to at least 82 Ma. In contrast, Hawaiian age progression was much faster since at least $\sim$15 Ma and possibly as early as $\sim$27 Ma. Linear age-distance relations for the Hawaii-Emperor and Louisville seamount chains predict $\sim$300 km overall hotspot relative motion between 80 and 47.5 Ma, in broad agreement with numerical models of plumes in a convecting mantle, and paleomagnetic data. We show that a change in hotspot relative motion may also have occurred between $\sim$55 Ma and $\sim$50 Ma. We interpret this change in hotspot motion as evidence that the HEB reflects a combination of hotspot and plate motion changes driven by the same plate/mantle reorganization.

O'Connor et al. (2013), Constraints on past plate and mantle motion from new ages for the Hawaiian-Emperor Seamount Chain, Geochem. Geophys. Geosyst., 14, 4564–4584, doi:10.1002/ggge.20267.