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Hotspot and LLSVP Wander

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Six lines of evidence– paleomagnetism, plate-circuit analyses, sediment facies, geodynamic modeling, inter-hotspot distance analyses and geochemistry– indicate motion of the Hawaiian plume in Earth's mantle. Paleomagnetic results from Midway Atoll of the Hawaiian chain are in stark contrast to those from the Emperor seamounts, highlighting the latter as the signature of southward hotspot drift. The decreasing distance between Hawaii and the Louisville chain seamounts confirms a high rate of drift ($\sim$47 mm yr^{-1}), and excludes true polar wander as a factor relevant to explaining the observations. These findings further indicate that the overall Hawaiian-Emperor chain bend morphology was produced by changes in hotspot motion, not plate motion. The rapid southward plume movement was likely produced by a combination of top-down ridge-plume interaction, and bottom-up deep interaction of plume with the edge of the Pacific Large Low-Shear-Velocity Province (LLSVP) that was being actively deformed by subduction. The Midway paleomagnetic data indicate that the Hawaiian plume had arrived at its current latitude by 28 Ma. When compared versus plate circuit predictions, these data suggest $\sim$19 mm yr^{-1} of motion of the surface expression of the African LLSVP (i.e., Indo-Atlantic hotspots) in Oligocene to Miocene times (28-10 Ma). More rapid LLSVP apparent motion can occur due to deformation by subducting slabs. These slow and episodically more rapid rates of motion could lead to thousands of kilometers of net movement of the surface expression of LLSVPs when viewed on a 100-million-year timescale. Thus, while LLSVPs are ancient ($>$100 million years old) they are not fixed, but should be expected to continually move as they are affected by deep mantle convection.