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True Polar Wander and the Origin of the Hawaiian-Emperor Bend: New Evidence

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We present an updated apparent polar wander (APW) path for the Pacific plate constructed from paleomagnetic poles determined from the skewness of marine magnetic anomalies, from equatorial sediment accumulation rates, and from paleocolatitudes of vertical cores of igneous rock. While paleocolatitude data provide some constraints, their usefulness is limited because they only limit the pole position in one direction, and the uncertainty in that direction is large because of the challenges of averaging secular variation. In contrast, secular variation contributes negligibly to the poles from skewness data, which give compact confidence limits for a well-defined interval of time. We review, update, or present seven useful poles available for chrons 12r, 20r, 24r, 25r, 26r, 27r-31, and 32, corresponding respectively to 32 Ma, 44 Ma, 56 Ma, 58 Ma, 60 Ma, 65 Ma, and 72 Ma.

An APW path for Pacific hotspots can be obtained by moving each Pacific plate paleomagnetic pole with the Pacific plate relative to the hotspots to a reconstruction that corresponds to the age of the pole. This path has a stillstand from 45 Ma to 12 Ma at a location (P1) about 3° from the present spin axis and a second stillstand from 81 Ma to 55 Ma at a location (P2) about 11° from the present spin axis. We hypothesize that the shift from P2 to P1 records an episode of true polar wander sometime between 55 and 45 Ma and that the shift from P1 to the present spin axis records another episode of true polar that has occurred since 12 Ma and may continue today. We test these hypotheses by comparing the APW path of Pacific hotspots with the APW path of Indo-Atlantic hotspots and find them in agreement. Our results imply that global hotspots have moved in unison with respect to the spin axis and that the Hawaiian-Emperor Bend (HEB) does not record a change in motion through the mantle of the Hawaiian plume. Instead the HEB records a change in Pacific plate motion over a stationary plume as originally proposed by W. J. Morgan.