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Hotspot motion and reference frames for plate motion

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It has been common to consider hotspots as independent of mantle flow, using them as a frame of reference for plate motion and polar wander. An early and continued motivation and justification for this approach is the seemingly similar geometry of tracks, especially those in the Pacific Ocean basin. Here we review the paleomagnetic tests that have demonstrated both that hotspots are not fixed and that much postulated true polar wander is illusory. The failure of prior apparent polar wander paths for oceanic plates can be traced to a reliance on remote sensing data (modeling of seamount anomalies and marine magnetic anomaly skewness) and an underappreciation of their inherent uncertainties. Hotspots appear to move in large hemispherical groups, and two episodes of pronounced motion have been detected using robust paleomagnetic data sets. Indo-Atlantic hotspots show considerable latitudinal motion in the mid-Cretaceous. Motions become less important after 90 Ma; a bend is seen in some of the relevant hotspot tracks at this time. The Pacific hotspots, best exemplified by the Hawaiian hotspot, slow large latitudinal motion between 81 and 47 Ma (i.e. results of ODP Leg 197), with less motion after the Hawaiian-Emperor bend. Because of the hemispherical structure of the motion, and intervals of relatively slow motion, hotspots can provide useful approximations for reconstructions. However, global models for the last 160 million years should incorporate mantle flows that account for hotspot motion with minimal true polar wander.