



Current plate motions relative to the hotspots consistent with the MORVEL global set of plate relative angular velocities

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Estimates of plate motions relative to the hotspots are useful in investigations of plate driving forces, motion between hotspots, and in estimating the net-rotation of the lithosphere. HS3B-MORVEL is a new set of angular velocities of the plates relative to the hotspots. In HS3B-MORVEL, relative plate angular velocities are constrained to be consistent with those of MORVEL, which is a new closure-enforced global set of angular velocities. MORVEL describes the geologically current motions of 25 plates, 18 of which are determined solely from marine geophysical data, which typically average motion over hundreds of thousands to millions of years [DeMets, Gordon, and Argus 2010]. Seven other plates are tied in partly or entirely through geodetic data.

The HS3B data set builds on the HS3 data set, which includes two volcanic propagation rates and eleven segment trends and is determined from the age and location of volcanoes from four plates [Gripp and Gordon, 2002]. In HS3B we adjust the volcanic propagation rates from HS3 for a 10% bias in K/Ar age dates. In HS3B-MORVEL, the angular velocity relative to the hotspots of eight plates—Eurasia, Nubia, Somalia, Lwandle, Antarctica, Sundaland, Amur, and Yangtze—all differ insignificantly from zero. The motion of the other 17 plates differ significantly from zero ($p < 0.05$). The net rotation of the lithosphere is $\approx 0.1^\circ/\text{Myr}$ lower than found for HS3-NUVEL1A.

We construct two further sets of absolute plate angular velocities.

The first set of angular velocities, T57-MORVEL, is determined from the data set of Morgan and Phipps Morgan [2006], which consists of 57 trends of widely distributed hotspot tracks. All angular velocities in T57-MORVEL lie outside the 95% confidence limits of the corresponding HS3B-MORVEL angular velocity. We consider two hypotheses to explain this discrepancy: (1) Pacific hotspots move relative to non-Pacific hotspots at $\approx 5\text{--}15\text{ mm/yr}$, or (2) anachronism—some T57 trends may average plate motion over tens of millions of years, while the HS3B data average over only the past $\approx 6\text{ Myr}$.

The second set of angular velocities, SKS-MORVEL, uses the shear-wave splitting data set of Kreemer [2009] to constrain the direction of plate motion. All angular velocities in SKS-MORVEL lie within the 95% confidence limits of the corresponding HS3B-MORVEL angular velocity. Thus, the alternative "absolute" frames of reference from the orientation of shear-wave splitting and from hotspot tracks are mutually consistent.