## Net Characteristics of Plate Tectonics: Implications for Mantle Dynamics, Dynamic Topography, and Sea Level

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Although constraints on the history of mantle flow are difficult to obtain, tectonic reconstructions contain information about the longest wavelength patterns of mantle flow that drove plate motions in the past. To examine the influence of this long-wavelength flow on global geodynamics, we computed the dipole and quadrupole moments (harmonic degrees 1 and 2) of the spherical vector fields associated with tectonic reconstructions of plate motions back to 250 Ma. Areas of dipole or quadrupole divergence lie above regions of major mantle upwelling, and convergence regions reside atop major mantle downwellings. To constrain the time-dependence of dynamic topography associated with these upwellings and downwellings, we used a numerical model of present-day mantle flow to relate degree-1 and degree-2 patterns of dynamic topography to the orientations and amplitudes of the dipole and quadrupole moments of presentday plate motions. We then apply this relationship to the dipole and quadrupole moments of past plate motions to compute the long-wavelength components of dynamic topography for the Mesozoic and Cenozoic. Continental motions over this time-evolving dynamic topography predict patterns of continental uplift and subsidence that can be related to geological observations of continental surfaces relative to sea level. Net uplift or subsidence of the global seafloor can also induce eustatic sea level changes. We infer that dispersal of the Pangean supercontinent away from upwelling beneath Africa may have exposed the seafloor to an increasingly larger area of positive dynamic topography since the early Mesozoic that has caused up to 100 m of sea level rise during this time period. This component of sea level change helps to balance observations of Cretaceous and Cenozoic sea level change with an estimated total sea level budget that includes concurrent tectonic and climatic influences that produce sea level drop of up to  $\sim 250$  m.