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Feedback between mountain belt growth and plate convergence

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While it is generally assumed that global plate motions are driven by the pattern of convection in the Earth's mantle, the details of that linkage remain obscure. Bouyancy forces associated with subduction of cool, dense lithosphere at zones of plate convergence are thought to provide significant driving force, but the relative magnitudes of other driving and resisting forces are less clear, as are the main factors controlling long term changes in plate motion. The ability to consider past (e.i. paleomagnetic reconstructions) as well as present (e.i. geodetic techniques) plate motions provides significant additional constraints, because changes in plate motion are necessarily driven by changes in one or more key driving forces, which may be inferred from independent data. Here we present for the first time a model that explicitly links global mantle convection and lithosphere models to infer plate motion changes as far back as Miocene time. We demonstrate that the surface topography generated at convergent margins is a key factor controlling the long term evolution of plate motion. Specifically, the topographic load of large mountain belts and plateaus may by itself consume a significant amount of the driving forces available for plate tectonics, by increasing the frictional coupling between downgoing and overriding plates.