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Feedback between Andean mountain belt growth and plate convergence: a climate-driven process?

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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. The ability to consider past as well as present plate motions provides significant additional constraints, because changes in plate motion are necessarily driven by changes in one or more driving or resisting forces, which may be inferred from independent data. Here we first exploit the capabilities of forward and inverse tectonic models of the Andean region to infer plate motion changes as far back as Miocene time. By accurately predicting observed convergence rates between Nazca and South America plates over the last 10 Myrs, we demonstrate that the growing topographic load of the Andes increases frictional resisting forces between downgoing and overriding plates and thus consumes a significant amount of the driving force available for plate tectonics. This result suggests a strong feedback between mountain belt growth and plate convergence. We then speculate about the possibility of a role of climate in controlling such a process. Recently some authors have argued that the growing Andean belt might have acted as an orographic barrier against moisture bearing winds coming from east. The initial uplift of the Andes resulted then in regional aridity and reduced erosion, particularly on the western flank of the belt. Low erosion rates, however, have been implicated as a pre-requisite for the development of large plateaus such as the Puna and the Altiplano, which affect the motion between Nazca and South America plates. In other words climate may

potentially act as a force on plate tectonics.