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Spatial variations in the effective elastic thickness, Te, along the Andes: implications for subduction geometry.

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We have estimated the effective elastic thickness, Te, along the Andean margin using the multitapered Bouguer coherence. The pattern of Te variations reflects the interactions between the subducting slab and the pre-existing terrane structure. In the forearc, conductive cooling of the upper plate by the subducting slab exerts primary control on the rigidity, resulting in Te that is largest ($\sim$40 km) where the oceanic plate is oldest and coldest ($\sim$20° S). In the central Andes, Te is relatively low ($\sim$20 km) along the volcanic chain, the Altiplano and Puna plateaus. We interpret that this weakening reflects the existence of a high geothermal gradient owing to advective magmatic processes and a very weak lower crust throughout this region. In the bend region, east of the plateau, high Te delineates underthrusting of the cratonic Brazilian shield beneath the Eastern Cordillera and Sierras Pampeanas. Finally, regions of flat subduction located to the north and south of the plateaus are characterized by high Te. We suggest that the large rigidity we observe may indicate both coupling to flat slab subduction and residual strength of a pre-existing, thick and depleted lithosphere. We further speculate that the lithospheric structure of the upper plate may influence the subduction geometry. We propose that the low viscosity asthenosphere beneath thin continental lithosphere allows the slab to detach from the continent's base and sink into the mantle at normal angles. In contrast, the thicker layer of high-viscosity lithosphere under cratons may prevent the slab from detaching by inhibiting flow of the asthenosphere into the low-pressure zone above the slab, thereby resulting in flat subduction. Only after prolonged hydration and weakening of the cratonic mantle, asthenospheric material may flow into the wedge region and allow the slab to sink into the mantle at a normal angle.