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Variable mechanical coupling along the Andes and implications for trench curvature, shortening, and topography

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The Andean system, where the Nazca plate undergoes continental South America, is often regarded as the archetype of convergent margin where spatial and temporal correlations between the correlations between the development of trench curvature, shortening of the overriding plate, and topography uplift stand out from the geologic record. Despite the large amount of observations available, the details of those links are still matter of debate. There are, nevertheless, distinctive evidences suggesting that the degree of mechanical coupling between converging plates - that is the amount of resistive force mutually transmitted between plates and opposite to their respective motions - may significantly vary along the Andean margin at present-day. Here we present laboratory experiments of analog subduction that for the first time explicitly relate trench curvature, shortening, and the distribution of topographic volume along the convergent margins to lateral variations in mechanical coupling between subducting and overriding plates. The ability of the overriding plate to slide above the subducting one is significantly inhibited by strong mechanical coupling. This inference applies in particular to the central Andean margin as opposed to its northern and southern limbs. Consequently, the South American plate shortens more, and the trench advances less than elsewhere along the margin, generating the peculiar shape observed along Andes at present-day. The presence of the overriding plate and its degree of coupling with the subducting slab impact the evolution of convergent systems perhaps more that previously thought.