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Regional Relative Tectonic Activity Assessment of Structures in the Pampean Flat Slab Segment of Argentina from 30°S to 32°S

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The Pampean flat slab segment of the Central Andes in Argentina is a broad active deformation zone which involves both plate boundary-related and intraplate deformation. To the west, plate boundary-related deformation is dominated by thin-skinned fold-and-thrusts of the Precordillera region, while to the east, intraplate deformation involves thick-skinned reverse faults of the Sierras Pampeanas region. Previous GPS studies and absolute dating of displaced geomorphic features suggest that most of the active permanent deformation occurs in between these two regions at the Andean orogenic front and that there is a west-to-east trend of decreasing shortening rates. However, GPS stations and sites with geomorphic slip rate measurements are currently too sparse and cover too short a time period to make reliable inferences about the longer-term distribution and relative rates of deformation. Mountain range-scale morphometric indices, on the other hand, reflect tectonic activity at least as far back as the Pleistocene.

In this study, we measured morphometric indices (hypsometric integral and curves, basin elongation ratio, basin volume-to-area-ratio, valley floor width-to-height ratio, mountain front sinuosity, and normalized steepness indices of rivers) from 10 different N-S striking, range-bounding faults that span both the Precordillera and Sierras Pampeanas regions. We use these data to assess the regional relative tectonic activity of major Quaternary deformation features in the Pampean segment of the Central Andes.

Mean values for each morphometric index are nearly uniform for the 10 mountain-range bounding faults in this study. While there is a considerable spread in the values of morphometric indices along each fault, in most cases the mean lies close to the peak of frequency distribution plot of these values. We attribute the spread in the values of morphometric indices along each fault to normal along-strike variation in uplift rates, segmentation, and tapering/increase of deformation rates at fault termini.

Even when variations in climate and geology are considered, the nearly uniform trend in mean values for each morphometric index suggests a nearly uniform uplift rate for faults from west to east. However, shortening rates are generally higher for the Precordillera fold-and-thrusts (in the west) than the Sierra Pampean thick-skinned reverse fault (in the east), due to the shallower fault dips for Precordilleran structures. This similarity in trend with decadal slip rate gradients from GPS studies indicate that the stress-field has been constant since at least the Pleistocene. Variations observed in relative uplift rates along each fault in this study can be used for determining sites that warrant further detailed studies of slip rates and evaluation of associated seismic hazards.