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**Andean shortening, inversion, and exhumation associated with thin- and thick-skinned deformation in southern Peru**

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Supplementary Materials

Auxiliary Figures

All Auxilary figures have “Aux” prefix. There are 2 plots from the Coasa pluton area (Eastern Cordillera) and the Subandes. These plots compare effective uranium (eU) vs age, and grain size (Ft) vs age. These plots show that there is no clear relationship between eU and Ft, suggesting thermochronologic analyses reflect grain cooling history rather than grain composition or size dependency.

Supplementary Figure S1 caption

A) DEM topography of Central Andes (after Garzione *et al.* 2014) showing general study area (red dashed rectangle). B) Compiled 1:100000 geology map quadrangles at 1:250000 scale. Bedding orientation, fault, fold data from own observations. Note locations of new and previous thermochronology samples. C) Line-length balanced cross-section from transects across study area.

Supplementary Table S1

This data set contains all of the detrital zircon U-Pb data. The data was collected and reduced at the Arizona LaserChron Laboratory.

Column 1: Sample name

Column 2: U (ppm)

Column 3: 206Pb/204Pb

Column 4: 207Pb/235U (Ma)

Column 5: Percent error

Column 6: 206Pb/238U (Ma)

Column 7: Percent error

Column 8: Error corr.

Column 9 206Pb/238U (Ma)

Column 10: Error (Ma)

Column 11: 207Pb/235U (Ma)

Column 12: Error (Ma)

Column 13: 207Pb/235U (Ma)

Column 14: Error (Ma)

Column 15: Concordance (%)

Supplementary Table S2

This data set contains all results for apatite (U-Th)/He analyses. The data was collected at the University of Tübingen.

Column 1: Sample name

Column 2: 4He (mol)

Column 3: 238U (mol)

Column 4: 235U (mol)

Column 5: 232Th (mol)

Column 6: 147Sm (mol)

Column 7: Uncorrected Age (Ma)

Column 8: Ft correction

Column 9: Alpha corrected Age (Ma)

Column 10: Mean age (Ma) – of sample

Column 11: Standard Deviation (Ma) of mean age

Supplementary Table S3

This data set contains all results for apatite (U-Th)/He analyses. The data was collected at the University of Tübingen.

Column 1: Sample name

Column 2: 4He (mol)

Column 3: 238U (mol)

Column 4: 235U (mol)

Column 5: 232Th (mol)

Column 6: Uncorrected Age (Ma)

Column 7: Ft correction

Column 8: Alpha corrected Age (Ma)

Supplementary Table S4

This table contains the location and elevation data for the apatite and zircon (U-Th)/He data reported in this study. It does not include sample information for previously published studies.

Column 1: Sample name

Column 2: Latitude (degrees)

Column 3: Longitude (degrees)

Column 4: Region

Column 5: Elevation (m)