

Description of Additional Supplementary Files

Supplementary Data 1: Igneous Geochronology Date Compilation (Fig. 2A; Supplemental Figure 1)

Supplementary Data 2: Compilation of Bedrock Nd isotope data (Fig. 1B; Fig. 3B)

Supplementary Data 3: Compilation of Bedrock and Detrital Zircon Lu-Hf data (Fig. 1B; Fig. 3B)

Supplementary Data 4: Apatite (U-Th-Sm)/He Thermochronology Date Compilation (Fig. 2A; Supplemental Figure 2; Supplemental Figure 3)

Supplementary Data 5: Apatite Fission Track Thermochronology Date Compilation (Fig. 2A; Supplemental Figure 2)

Supplementary Data 6: Deformation Front constraints from synorogenic stratigraphic data, structural and cross-cutting relationships, thermochronology data, and thermokinematic modeling (Fig. 2A).

Supplementary Data 7: Chronostratigraphic data used for Retroarc foreland basin sediment accumulation histories (Fig. 3D). 1: Calingasta; 2: Talacasto; 3: Manantiales; 4: Albarracín; 5: proximal Bermejo (Sierra Villicum); 6: proximal Bermejo (Mogna Anticline); 7: distal Bermejo (Ampacama)