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STRAIN LOCALIZATION IN THE LOWER CRUST OF A COLLISIONAL OROGEN: INTEGRATED PETROLOGIC, MICROSTRUCTURAL, AND THERMOCHRONOLOGIC ANALYSES OF THE BAJO PEQUEñO SHEAR ZONE, SIERRA DE PIE DE PALO, ARGENTINA

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Combined field and analytical data from a ductile shear zone within the Sierra de Pie de Palo document major tectonism in the latest stages of a collisional orogeny, and indicate regional- to local-scale strain localization with progressive deformation. The top-to-the-west, 80-m thick Bajo Pequeño Shear Zone (BPSZ) records significant shortening and exhumation at ~400 Ma, well after the Laurentian Precordillera terrane collided with Gondwana at ~465 Ma. THERMOCALC results from syn-tectonic metamorphic assemblages outside of the shear zone in the metapelitic footwall and metaigneous hanging wall suggest the onset of deformation in the lower crust (~12 kbar, ~660-680 ^{o}C), as the hotter hanging wall was thrust over the footwall. Though previous muscovite Ar-Ar ages in the lower part of the footwall show cooling below muscovite closure at 435 Ma (Mulcahy et al., 2011), new muscovite ages proximal to the shear zone indicate resetting of the Ar system at ~405-400 Ma. These thermobarometric and thermochronologic data together indicate significant thermal fluctuations in the lower crust of the evolving orogen even at constant depth. Our microstructural observations additionally show that BPSZ deformation was accommodated by distributed strain during early shear zone activity at elevated metamorphic temperatures, but localized to the core of the shear zone during cooling. Our comprehensive BPSZ dataset allows direct comparison with other regional studies, and indicates two important conclusions: (1) Shortening and exhumation along the BPSZ occurred synchronously with activity on other highly-localized structures, suggesting a major period of lower-crustal reorganization associated with the establishment of a new plate boundary, >60 My after the Precordillera collision initiated. (2) As the collisional orogen evolved, strain became increasingly localized along narrower high-strain zones independent of changes in crustal depth, indicating a regional pattern of post-collisional strain localization. We ascribe this localization to thermal relaxation associated with the cessation of arc volcanism, but suggest that other factors may have played an important role, such as changes in plate velocities or the presence/absence of partial melt along individual shear zones.

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