

CONTEMPORARY SHEARING ON THE TUCURRIQUE FAULT: EVIDENCE FOR AN ACTIVE PULL-APART BASIN AT PEJIBAYE, COSTA RICA

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Identifying active faults and estimating slip rates in central Costa Rica are critical to understanding: (1) geological hazards; and (2) the upper plate architecture of the Middle America Trench (MAT). The Tucurrique fault has been interpreted to be one of the more active faults within a broad NW-striking zone of dextral shearing referred to as the Rio Sucio – Atirro fault system. Here we provide geomorphic and geochronologic evidence that a small intermontane basin near Pejibaye is an active pull-apart structure forming at a releasing bend in the Tucurrique fault. Longitudinal profiles of the Pejibaye, Gato, and Tepemechin Rivers show upstream knick points that suggest structural control of stream gradients. Below these knick points the rivers are sediment dominated and each preserves well-developed terraces. Downstream of the confluence of these three rivers, the trace of the Tucurrique fault is marked by the transition to a bedrock channel and narrow bedrock canyon on the Pejibaye River.

Within the basin several observations suggest ongoing deformation. The course of the Tepemechin River displays a prominent right turn upon entering the basin, after which it flows along the foot of the steep slopes that mark the eastern margin of the basin. Weakly preserved triangular facets occur on the slopes above the stream. We interpret the river to be localized along an active normal fault. Comparable triangular facets occur along the western margin of the basin above the Pejibaye River. In addition, terraces of the Pejibaye River appear to display offset risers. Specifically the T2/T3 riser displays ~20 m of dextral offset and the T3/T4 riser displays ~30 m of dextral offset. These offsets are aligned with a dextrally displaced bedrock spur to the south. Collectively the offset features are interpreted to reflect a cross-basin fault. The ages of the offset terraces have not yet been determined, however, wood found within a thick bentonite layer (altered volcanic ash) exposed at the cutbank of the Tepemechin River where it turns right yields a radiocarbon age of 4.02 ± 0.07 Ka. Wood collected from another bentonite layer exposed upstream yields a radiocarbon age of 31.45 ± 0.55 Ka. These samples come from the upstream portion of the pull-apart basin and suggest basin growth was under way by Late Pleistocene time.

Our findings have two important implications. First they suggest that the slip rate on the Tucurrique fault might be obtained with additional work to establish the geometry of the active fault strands and the ages of offset geomorphic features. This is important because the fault may direct a large component of contemporary dextral shear into the more densely populated areas from Tucurrique westward into the Central Valley. Obtaining slip rate estimates on active faults continues to be an important yet elusive goal. Second, our results suggest that Late Pleistocene to Holocene eruptive products from Turrialba Volcano occur SE of the volcano.