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Geothermal asymmetry across a continental transform fault inferred from thermochronology: the Motagua Fault Zone, Guatemala

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Strike-slip faults juxtapose crustal blocks with different geodynamic origins and potentially different thermal structures. Large-magnitude horizontal displacements along these faults may juxtapose terranes of contrasted thermal regimes. The effect of strike-slip faulting on the cooling histories that are derived from thermochronological dating remains poorly documented. We have used the zircon (U-Th)/He method in order to construct age-elevation profiles across the Motagua fault zone, a 500 km-long segment of the transform boundary between the North American and Caribbean plates. We combine our results with published thermochronological data to document a sharp cooling age discontinuity across the Motagua fault. This discontinuity could be interpreted as a difference in denudation history on each side of the fault. However, a low-relief Miocene erosional surface extends across the fault; this surface has been uplifted and incised and provides a geomorphic argument against differential denudation across the fault. Using surface heat-flow data, thermochronological age-elevation profiles and three-dimensional thermokinematic modeling, we propose that strike-slip displacement has juxtaposed the cold Maya block (s.s.) to the north against the hot, arc-derived, Chortís block (s.s.) to the south. Large-scale horizontal displacement along the Motagua fault maintained this geothermal asymmetry across the fault and explains both the age discontinuities and the age-elevation patterns. This study illustrates how thermochronology can be used to detect large strike-slip displacements.