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Intra-Arc extension in Central America: Links between plate motions, tectonics, volcanism, and geochemistry

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This study revisits the kinematics and tectonics of Central America subduction, synthesizing observations of marine bathymetry, high-resolution land topography, current plate motions, and the recent seismotectonic and magmatic history in this region. The inferred tectonic history implies that the Guatemala-El Salvador and Nicaraguan segments of this volcanic arc have been a region of significant arc tectonic extension; extension arising from the interplay between subduction roll-back of the Cocos Plate and the $\sim$10-15 mm/yr slower westward drift of the Caribbean plate relative to the North American Plate. The ages of belts of magmatic rocks paralleling both sides of the current Nicaraguan arc are consistent with long-term arc-normal extension in Nicaragua at the rate of $\sim$5-10 mm/yr, in agreement with rates predicted by plate kinematics. Significant arc-normal extension can 'hide' a very large intrusive arc-magma flux; we suggest that Nicaragua is, in fact, the most magmatically robust section of the Central American arc, and that the volume of intrusive volcanism here has been previously greatly underestimated. Yet, this flux is hidden by the persistent extension and sediment infill of the rifting basin in which the current arc sits. Observed geochemical differences between the Nicaraguan arc and its neighbors which suggest that Nicaragua has a higher rate of arc-magmatism are consistent with this interpretation. Smaller-amplitude, but similar systematic geochemical correlations between arc-chemistry and arc-extension in Guatemala show the same pattern as the even larger variations between the Nicaragua arc and its neighbors. We are also exploring the potential implications of intra-arc extension for deformation processes along the subducting plate boundary and within the forearc 'microplate'.