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The Cocos Ridge drives collision of Panama with northwestern South America

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The collision of the Panamanian isthmus with northwestern South America is thought to have initiated as early as Oligocene - Miocene time (23-25 Ma) based on geologic and geophysical data and paleogeographic reconstructions. This collision was driven by eastward-directed subduction beneath northwestern South America. Cocos – Caribbean convergence along the Middle America Trench, and Nazca – Caribbean oblique convergence along the South Panama Deformed Belt have resulted in complex deformation of the southwestern Caribbean since Miocene - Pliocene time. Subduction and collision of the aseismic Cocos Ridge is thought to have initiated <3.5 Ma and has been linked to: 1) late Miocene-Pliocene cessation of volcanism and uplift of the Cordillera de Talamanca; 2) Quaternary migration of the volcanic arc toward the back-arc; 3) Quaternary to present deformation within the Central Costa Rica Deformed Belt; 4) Quaternary to present shortening across the fore-arc Fila Costeña fold and thrust belt and back-arc North Panama Deformed Belt (NPDB); 5) Quaternary to present outer fore-arc uplift of Nicoya Peninsula above the seamount domain, and the Osa and Burica peninsulas above the ridge; and 6) Pleistocene to present northwestward motion of the Central American Fore Arc (CAFA) and northeastward motion of the Panama Region. We investigate the geodynamic effects of Cocos Ridge collision on motion of the Panama Region with a new geodynamic model. The model is compared to a new 1993-2015 GPS-derived three-dimensional velocity field for the western Caribbean and northwestern South America. Specifically, we test the hypotheses that the Cocos Ridge is the main driver for upper plate deformation in the western Caribbean. Our models indicate that Cocos Ridge collision drives northwest-directed motion of the CAFA and the northeast-directed motion of the Panama Region. The Panama Region is driven into the Caribbean across the NPDB and into northwestern South America, which is also converging with the Panama Region, pushing it toward the west-northwest. Therefore, modern collision of Panama with northwestern South America is driven by collision of the Cocos Ridge.