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A 3D viscoelastoplastic finite element model of fault interaction and evolution in the Pacific-North American plate boundary zone

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The San Andreas Fault (SAF) is the transform boundary between the Pacific and the North American plates, yet up to 25% of the relative plate motion is now accommodated by the Eastern California Shear Zone (ECSZ). We have investigate the inception and development of the ECSZ and its geodynamic interactions with the SAF using a three-dimensional viscoelastoplastic finite element model. For a given fault configuration of the plate boundary zone, the model simulates long-term slip on the faults and plastic strain outside the faults. Our results show that the formation of the Big Bend of the SAF around 5-12 Ma impeded fault slips and caused strain localization along the ECSZ. Development of the ECSZ was further enhanced by the activation of the Garlock Fault (GF) and lithospheric weakening due to the encroachment of the Basin and Range extension. Similarly, the San Jacinto Fault (SJF) in southern California developed along a belt of localized strain, which resulted from the formation of the restraining bend along the San Bernardino Mountains segment of the SAF $\sim$2 Myr ago. Once activated, the SJF reduced slip on both the southern SAF and the ECSZ across the Mojave Desert. These results indicate causative relationship between the SAF, the ECSZ, the GF, and the SJF. The inception of the ECSZ is the consequence of the evolving SAF plate boundary zone that continuously adjusts itself to accommodate the relative plate motion.