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Tectonic evolution of the El Salvador Fault Zone. Insights from analogue experiments.

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The El Salvador Fault Zone (ESFZ) is an active, c. 150 km long and 20 km wide segmented, dextral strike-slip fault zone within the El Salvador Volcanic Arc striking N90°-100°E. Although several studies have investigated the surface expression of the ESFZ, little is known about its structure at depth and its kinematic evolution. Our analysis of structural field data, remote sensing images and morphometric indices reveals a trenchward migration of the volcanic arc and furthermore suggests that not all structures within the ESFZ can be explained within the current tectonic context, but require a phase of extension or an extensional component of deformation at some stage in the evolution of the ESFZ. Such an extension and trenchward migration of the volcanic arc could be related to subduction roll-back of the Cocos Plate beneath the Chortis Block in Mio-Pliocene times. Such a possible evolution leads to open questions that we address in our research: Is the ESFZ a neo-formed fault zone, i.e. did it form during one phase of strike-slip or transtensional deformation, or do the structures in the ESFZ reflect a two-phase evolution, i.e. an early phase of extension overprinted by a later phase of strike-slip or transtension? Did subduction roll-back occur beneath El Salvador?

We carried out analogue model experiments to test whether or not an early phase of extension is required to form the present-day fault pattern in the ESFZ. Analogue modeling is an effective tool in testing various hypotheses, as it allows the experimenter to control specific parameters and to test their influence on the resulting structures. Our experiments suggest that a two-phase tectonic evolution best explains the ESFZ: an early pure extensional phase linked to a segmented volcanic arc is necessary to form the main structures of the ESFZ and can explain the shallow geometry of the fault zone. This extensional phase is followed by a strike-slip dominated regime, which results in inter-segment areas with local transtension and segments with almost pure strike-slip motion.