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Indirect reconstruction of magmatic feeding system geometry during an explosive eruption: the example of the 1913 eruption at Fuego de Colima volcano (Mexico)

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The geometric evolution of the conduit system during large eruptions is a topic in present day volcanology. Here, a picture of the evolution of a conduit system is provided for the 1913 AD eruption at Colima volcano (México), coupling field data and numerical simulations. This eruption represents one of the largest events in the historical record of Colima. It occurred in three phases: opening, a vent-clearing phase that destroyed the summit dome, and a Plinian phase. The magma chamber was hypothesized at about 6 km of depth. We investigated a new method to simulate the Plinian phase trough the CPIUD code, using as constraints the subsurface data and the independently inferred Mass Discharge Rates. Results show best matches for pure dyke and hybrid (dyke evolving to a shallow cylinder) geometries having fragmentation levels located at depths less than 2 km. The best solutions restricted to the pure dyke yield a minor axis=30 m and major axis in the range of 100-400 m, or minor axis=20 m and major axis in the range of ~100-1600 m. Results for a hybrid geometry are restricted to transition depths between dyke and cylinder from 500 to 1500 m. For the 500 m depth, the best solutions have minor axis of ~30-40 m and major axis in the range of 200-1600 m. For the 1000 and 1500 m depths, we found best solutions for minor axis of ~30-40 m and major axes in the range of 200-2000 m. Moreover, we compared the volumes for all best solutions with the published volumes of the 1913 eruption, finding reasonable matches with the volume contained in the feeding dyke. This allows hypothesizing that the 1913 eruption was driven by filling and emptying of the feeding dyke, with limited contribution of magma from the chamber during the eruption.