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DEM-based palaeotopography reconstructions and evolution through time of the recent volcanoes in Martinique Island (Mount Conil and Mount Pelée).

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Martinique Island, located in the central part of the Lesser Antilles arc (14°40'N, 61°W), has been built since 25 Myr and consists of eight volcanic complexes geographically and geochemically distinct. In this island, volcanic activity has progressively migrated north-westward since the end of the Oligocene, to be presently located at the active Mount Pelée volcano. Determining the growth rate and the evolution of a given volcano is critical to understand timing of its eruptive processes, to identify any possible periodicity of volcanic episodes, and, to a broader extent, to complete the global database of volcanic output rates. Cumulative erupted volume, as a function of time, is a useful tool for estimating long-term activities of volcanoes, such as eruptive rate calculations. However, no data about volumes of individual edifices exist for the main volcanically active Lesser Antilles islands, except for Basse-Terre Island (Guadeloupe), Morne Jacob volcano (Martinique) and Montserrat. We present here a Digital Elevation Model (DEM)-based geomorphological reconstruction of the Conil – Pelée volcano, the most recent volcanic complex from Martinique Island, with activity spanning the last 543 ka. The main purpose of the present study is to conduct geomorphologic survey to model successive paleotopographies at each key stage of the complex, including both constructional stages and destructional events. Finally, we aim at quantify volumes, construction rates, and erosion rates showing the evolution of the complex. Taking advantage of 60 new K-Ar ages we have recently obtained on effusive products, we have interpreted DEM and digitalized geological map to model paleotopographies and compute edifice volumes as well as the volumes removed by erosion or previously recognized mass wasting events. The rather good preservation of volcanic landforms and the high temporal resolution available allow us to discriminate 10 successive stages and model these surfaces evolution though time by construction – erosion processes. Mount Conil emerged around 543 $\pm$ 8 ka and emitted a total of 36 km3 of andesites. It has been built within two stages until 126 $\pm$ 2 ka, when a flank collapse destroyed $\sim$17 km3 of the southwestern flank, producing an inland 10 km3 debris-avalanche deposit, and triggered the eruption of Piton Marcel lava dome (0.1 km3). Then, the ancient Mount Pelée has covered most of the previous edifice between 126 and 25 ka with $\sim$25 km3 of material. At 25 ka, a $\sim$5 km3 collapse destabilized the western flank of the volcano, and has been followed by St.Vincent-style eruptions, mainly channeled within the scar up to 9 ka (intermediate Pelée). The volume of the Intermediate Pelée, covering the previous edifice, has been modeled and estimated at 12 km3. This stage ended with another south-westward flank collapse at 9 ka, which destroyed about 2 km3 of the entire volcano. Finally, recent products were channeled inside the last horse-shoe shaped scar and some pyroclastic flows were directed towards the east and the west. The actual edifice has a total aerial volume of $\sim$58 km3 and a mean construction rate of 0.1 km3/kyr. Although our estimates are based on aerial effusive activity, they should be considered as minimum values. However, we propose a relatively low magmatic production for northern Martinique Island, between 0.08 and 0.75 km3/kyr, which is in agreement with Basse-Terre and Montserrat rates. The new estimates for northern Martinique obtained here, will be an interesting contribution for compilations of magmatic output rates in the Lesser Antilles island arc. Moreover, the original DEM-based method used here could be a good example to study other volcanic settings to obtain useful and valuable data to create a global database of volumes and rates.