



Evolution of Martinique Island since the Oligocene inferred from K-Ar dating, geochemical analyses and geomorphological reconstructions

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Martinique is the island where the most complete history of the Lesser Antilles island arc can be studied.

Geochronological and geochemical studies were investigated on more than 100 samples from this island to constrain its evolution, with a special emphasize on the initiation and westward migration of the volcanic front since the Oligocene. The Old arc has been active from 24.8 to 20.8 Ma. Then, the submarine to subaerial Intermediate arc was active in Martinique between 16.1 and 7.1 Ma. During the Pliocene, Morne Jacob volcano was built from 5.5 to 1.5 Ma, and experienced a creeping of its northern flank at about 2.2 Ma, inducing geochemical changes in shallow reservoirs and late eruptions of more basic lavas. Monogenetic volcanoes with various dynamisms erupted in the southwestern Trois Ilets peninsula (2.4 to 0.345 Ma). Simultaneously, the Carbet Complex (1 Ma – 322 ka), Mont Conil (550 – 125 ka), and finally the Mount Pelée were active along the western sector of the island.

Taking advantage of the new K-Ar ages we have obtained on effusive products from Morne Jacob and the Mount Conil – Mount Pelée complex, we have interpreted Digital Elevation Model and digitalized geological map. The rather good preservation of landforms and the high temporal resolution available allowed us to model paleotopographies and compute edifice volumes as well as the volumes removed by erosion or by previously recognized mass wasting events.

Considering the entire history of Morne Jacob shield volcano, between 5.14 and 1.54 Ma, we obtain a total volume of 145 ± 32 km³ above the sea level, and a time-averaged construction rate of 0.040 ± 0.008 km³/kyr. With comparison between the reconstructed paleotopographies and the DEM of present topography, we have calculated an eroded volume of 18 km³ that have occurred during the last 1.5 Myr. Since ~543 ka, when Mount Conil emerged, it has emitted ~36 km³ of andesites. It was built within two distinct stages and its activity ended at 126 ka, when a flank collapse destroyed ~15 km³ of the southwestern flank. Then, between 126 and 25 ka, the ancient Mount Pelée covered most of the previous Mont Conil edifice. At 25 ka, a previously recognized collapse destabilized the western flank of the volcano, and has been followed by St. Vincent-style eruptions, mainly channelled within the scar up to 9 ka when a 2 km³ collapse occurred. Finally, recent products were channelled inside the last scar. The present edifice has a volume of 60 km³ with a mean construction rate of 0.1 km³/kyr.

Flank collapses have been recurrent processes on northern Martinique, typically at 337, 126, 25 and 9 ka. Our data support the regional scale observations that the whole recent Lesser Antilles arc experiences a high volcanic activity since 600 ka, probably linked to a permanent establishment of rising magma plumes in regularly spaced and tectonically controlled batches.