Can Kick 'em Jenny submarine volcano emerge? A slope stability analysis as a tool of assesment for a potential emersion in the Lesser Antilles Volcanic Arc..

Frederic Jean-Yves Dondin[1], Jean-Francois Marc Dorville[2], Richard E. Robertson[1]

[1]Seismic Research Centre, The University of the West Indies, St Augustine, Trinidad and Tobago, [2]Physic Department, Faculty of Sciences and Technology, The University of the West Indies, Mona, Jamaica

E-mail: fredericdondin@gmail.com

Volcanic islands are peculiar geomorphological reliefs generated in three volcanic contexts: (i) arc volcanism; (ii) rift volcanism ; (iii) hotspot volcanism. They represents the final result of a long sustained volcanic activity capable of overcoming the weathering condition (oceanic and atmospheric), and tectonic vertical movements. However the main factor of longevity of such type of island is their ability to remain stable. Indeed over the last three decades flank instabilities have been recognized as the main erosive factor of volcanic island arc since weak flanks affecting these islands can cause sector collapse events. In some cases one sector collapse can destroy not only the volcanic edifice of the island but also affect partially or entirely the island and can lead to its destruction. (e.g. Ritter volcanic island). In the Lesser Antilles Volcanic Arc, 47 evidences of sector collapse events have been recognized on almost all the 21 identified active volcanoes so far. On some islands (Dominica, Martinique, St-Lucia) some events were large enough to affect the island flank partially.

Kick 'em Jenny volcano is the only submarine active volcano of the Lesser Antilles Arc and one of its most active. This strato-volcano is located 8 km north of Grenada on the steep (slope ca. 22°) eastern flank of the Grenada Basin it culminates at -180 m u.s.l and the deepest sector within the vent is at -260 m u.s.l. In this study we focus on Kick 'em Jenny volcano since a recent study of Dondin et al., 2012 showed that the volcano during its eruptive history may have emerged above the sea level and formed an island before a large sector collapse destroyed the entire edifice. The associated slump deposit of ca. 4.4 km3 is located at the bottom of the remaining horseshoe-shaped structure and has a runout of 14 km. The edifice lies within this structure. Taking into account the current edifice relative proximity to the surface, its basement location upon a preexisting failure surface within a horseshoe-shaped structure on the steep eastern flank of the Grenada basin, one of the issue related to KeJ is to know if it can emerge and form an perennial island or collapse before reaching the surface.

To be able to answer to this question we present the first slope stability analysis for this volcano in order to assess its current level of stability and to evaluate its stability in case of future emersion due to a sustained eruptive activity. The Slope stability was performed using the open source Slope Stability Analysis Program (Borselli et al., 2011) based on the validated Limit Equilibrium Method. We investigate the potential tsunami hazard related to potential collapse of the volcano following two scenario a partial and a total collapse of the volcano.