Assessing long term hazards for la Soufriere of Guadeloupe volcano: insights from a new eruptive chronology, credible scenario definition, and integrated impact modelling

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Mild but persistant seismic and fumarolic unrest since 1992 at La Soufriere volcano prompted renewed interest in geologic studies, monitoring, hazard, risk modeling, and crisis response planning. We present results of our new detailed chronology for the last 12000 years of La Soufriere eruptive activity based on the stratigraphy of more than 250 outcrops and 181 new radiocarbon age dates. The magmatic activity of La Soufriere (frequency and magnitude) is significantly higher than previously interpreted with 16 eruptions in the last 9150 years. Activity over the last 12000 years consists of at least 10 major explosive eruptive phases with a large range in magnitude (erupted volume: 0.01 to 1 km3), and at least 9 dome forming eruptive phases of large magnitude (0.1 km3) characterized by an important explosivity including vulcanian pumice producing phases and the generation of at least 6 to 7 high energy pyroclastic density currents. At least 8 flank collapse events are associated with these eruptive events. La Soufriere activity is dominated by multistage eruptive events (flank collapse, dome growth, explosive open conduit activity) that occur over a short yet unknown span of time. Hence, base rate eruption probabilities for Soufriere of Guadeloupe can be updated now with this new chronology of activity. Moreover, eruptive recurrence, magnitude and intensity place quantitative constraints on the event tree of La Soufriere to elaborate credible scenarios in case the current unrest, with evidence of the involvement of magmatic fluids, leads to a renewal of activity at La Soufriere. Thus, the most probable scenario would involve a major dome forming phase that is likely to be associated with partial flank instability of the dome and a major explosive subplinian phase that could share some analogy to the 1530 AD event. However, the detailed reconstruction of the eruptive past also highlights the occurrence of smaller vulcanian explosive eruptions as well as less frequent Plinian eruptions of higher magnitude that could have much more widespread impact. As an example of what is being considered for each major eruptive scenario, we present preliminary results of computational deterministic as well as probabilistic simulations of subplinian tephra dispersal and fountain collapse PDCs. This serves as a basis for elaborating a quantitative framework for the assessment of their impact on vulnerable infrastructures, networks, and population including preliminary results on the influence of sociocultural risk perception and governance issues on disaster preparedness. This work has implications for volcano monitoring, risk informed decision making for crisis response and long term strategies of volcanic risk mitigation for Lesser Antilles volcanoes. Other authors: Denain, JC, Gherardi, M, Lesales, T, Bonnel, C, Heymann, A, Mas, M, Chenet, M, Magnier, A, Lemaitre, E, Baillard, M.D, Villemant, B and the CASAVA Consortium