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Spreading and collapse of big basaltic volcanoes

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Among the different types of volcanoes, basaltic ones usually form the most voluminous edifices. Because volcanoes are growing on a pre-existing landscape, the geologic and structural framework of the basement (and earlier volcanic landforms) influences the stress regime, seismicity, and volcanic activity. Conversely, the masses of these volcanoes introduce a morphological anomaly that affects neighboring areas. Growth of a volcano disturbs the tectonic framework of the region, clamps and unclamps existing faults (some of which may be reactivated by the new stress field), and deforms the substratum. A volcano's weight on its basement can trigger edifice spreading and collapse that can affect populated areas even at significant distance. Volcano instability can also be driven by slow tectonic deformation and magmatic intrusion. The manifestations of instability span a range of temporal and spatial scales, ranging from slow creep on individual faults to large earthquakes affecting a broad area.

In the frame of MED-SVU project, our work aims to investigate the relation between basement setting and volcanic activity and stability at three Supersite volcanoes: Etna (Sicily, Italy), Kilauea (Island of Hawaii, USA) and Piton de la Fournaise (La Reunion Island, France). These volcanoes host frequent eruptive activity (effusive and explosive) and share common features indicating lateral spreading and collapse, yet they are characterized by different morphologies, dimensions, and tectonic frameworks. For instance, the basaltic ocean island volcanoes of Kilauea and Piton de la Fournaise are near the active ends of long hotspot chains while Mt. Etna has developed at junction along a convergent margin between the African and Eurasian plates and a passive margin separating the oceanic Ionian crust from the African continental crust. Magma supply and plate velocity also differ in the three settings, as to the sizes of the edifices and the extents of their rift zones. These Supersite volcanoes, due to their similarities and differences, coupled with their long-time and high-level monitoring networks, represent the best natural laboratories for investigating the manifestations and mechanisms of spreading and collapse, the feedback process between spreading and eruptive activity (especially along rift zones), and the role of the regional geodynamics.