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Dike propagation driven by volcano collapse: a general model tested at Stromboli (Italy)

V. Acocella (1) and A. Tibaldi (2)

(1) Dip. Scienze Geologiche Roma Tre, Italy (acocella@uniroma3.it/0039-06-54888201), (2) Department of Geological Sciences and Geotechnologies, University of Milan-Bicocca, Italy

Volcano collapse can influence shallow magma emplacement, playing a crucial role in volcanic hazard. Analogue experiments are used to investigate how flank collapse affects dike propagation within volcanoes. Coloured water (magma analogue) is injected at the base of a gelatin cone (volcano analogue) with a horseshoe-shaped scarp, simulating the collapse. The injections form dikes that, on the side of the cone opposite to the collapse, become always radial. The dikes propagating from the cone centre to the collapse are deflected towards the collapse sides, becoming subparallel to them. Only dikes formed along the collapse axis (line passing through the mean points of the collapse, in map view) propagate radially within the collapse. Therefore, the stress reorientation due to the collapse unbuttressing focuses most dikes towards the collapse sides. This model can be applied to several laterally-collapsed volcanoes. In particular, we consider the Holocene dikes at Stromboli (Italy), which experienced major collapses on its NW flank. The dikes have a similar distribution and orientation, clustering along and parallel to the collapse sides. Nevertheless, in 2002-03 a dike propagated within the collapse infill, triggering a landslide and tsunami. This event is here interpreted as resulting from the current location of the summit conduit, along the collapse axis. Consistently with the experiments, this leads to dike propagation within the loose deposits of the collapse infill, rather than at its sides. Because of these conditions, further landslides and tsunamis may be expected during dike emplacement from the summit conduit at Stromboli.