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Structural significance of the 2004-05 Etna eruption and implications for flank deformation

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The development of the 2004-05 eruption at Etna (Italy) is investigated by means of field surveys, to define the current structural state of the volcano. In 2004-05, a fracture swarm, associated with 3 effusive vents, propagated downslope from the SE summit crater towards SE. This scenario could be easily explained with the lateral emplacement of dikes radiating from the summit, as observed at most eruptions at Etna. Nevertheless, some unusual features of this eruption suggest a more complex triggering mechanism. These are: the absence of precursory phenomena; a slower (by an order of magnitude) propagation of fractures; the lack of explosive activity, degassing and any eruption-related seismicity; a significant oblique shear along the fractures. The detailed analysis of the N-S trending fracture field developed in the summit area for the previous seven years permits to define this possible mechanism. In fact the NW-SE trending fractures formed in 2004-05 constitute the south-eastern continuation of a N-S trending fracture system which started to develop in early 1998, to the east of the summit craters. The overall 1998-2005 deformation pattern forms therefore an arcuate feature, whose geometry and kinematics are consistent with the head of a shallow flank deformation on the E summit of Etna. Similar deformation patterns have also been observed in analogue models of deforming volcanic cones. In this frame, the 2004-05 eruption was possibly induced by a dike resulting from the intersection of this incipient fracture system with the SE Crater. A significant acceleration of this flank deformation may be induced by any magmatic involvement. The central conduit of the volcano is presently open, constantly buffering any increase in magmatic pressure and any hazardous consequence can be expected to be limited. A more hazardous scenario may be considered with a partial or total closing of the central conduit. In this case, magmatic overpressure within the central conduit may enhance the collapse of

the upper eastern flank, triggering an explosive eruption associated with a landslide reaching the eastern lower slope of the volcano.