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Dynamics of the 1989 fracture system and relations with the Etna eruptive activity of the last 30 years

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On September 11, 1989, after four months of Strombolian activity at the summit craters, effusive activity began on Mt. Etna and lasted about a month.

The 1989 eruption of Mt. Etna was characterized by the formation of two fracture systems, striking NE-SW and NNW-SSE, and both starting from the SE Crater on September, 24.

The NE-SW system was followed by effusive activity while the NNW-SSE fractures opened for a length of 7 km without eruptive phenomena. Between September, 27 and October, 3 the fracture system propagated until it reached and cut the SP 92 provincial road (Zafferana - Rifugio Sapienza), near the 1792 effusive mouth, and continued southward for another 700 m.

We investigated the fracture southern branch dynamics through 30 years of ground deformation data collected by the discrete and continuous INGV monitoring networks. We considered levelling, GPS, EDM, and extensometers data. EDM and levelling measurements began in the 80s; on 2003 EDM measurements have been replaced by GPS.

During the 1989 eruption, EDM measurements showed variations of tens of centimeters on the lines close to the fracture.

Precise levelling discrete measurements revealed, in the period 4-16 October 1989 and during the 1991-1993 eruption a subsidence of some centimeters on benchmarks close to fracture.

A network of rod extensometers evidenced the fracture activation during the 2001 intrusion phases (12-17 July) measuring several centimeters of left lateral slip. Distance measurements and InSAR show signs of the fracture reactivation during the 2002 and 2018 eruptions.

Several authors show as the 1989 fracture zone connects the summit region of the volcano with the tectonic structures of the lower SE flank considering it as well part of the NNW-SSE oriented structure.

The dynamics of these last 30 years suggests that the 1989 fracture play an important role on the flank dynamics and strain distribution. It also represents a potential hazard to population because it represents a possible way of ascending magma also testified by cones aligned along the structure.