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Determining the long-term slip rate of the Pernicana Fault System, Mt. Etna, to improve earthquake forecast modelling

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The Pernicana fault system (PFS) is a complex active tectonic systems located in the NE sector of Mt. Etna. It represents the northern boundary of the sliding side of the volcano and plays an important role in the dynamics of the eastern flank. Several historic and recent earthquakes have occurred close to this structure with coseismic surface faulting and damage (e.g. 02/04/2010 earthquake, Mw = 4.2). The PFS is transtensive, characterised by complex of en echelon segments with a N 110° overall direction. The dip-slip component decreases to the East accompanied with a decreasing of seismic activity. The eastern-most segment is characterised by left aseismic creeping strike-slip motion.
The aim of this work is to constrain to constrain the long-term history of the PFS using 40Ar/39Ar and cosmogenic 3He ages of lava flows that are cut by the PFS in order to better understand the fault behaviour and improve the prediction of earthquake occurrence. We will present the first 3D shape of the PFS based on a network of detailed topographic profiles, to better constrain the variability of the fault scarp along strike and so the kinematics of the structure. In situ cosmogenic 3He exposure ages of two faulted lava flows from the central sector of PFS are used to determine the slip rate. Flow ages (1157 $\pm$ 230 yr and 1088 $\pm$ 96 yr) are combined with fault scarp heights to calculate an average vertical slip rate of about 11 mm/year over the last 1,000 years for the central section of the PFS. This rate is close to the rate determined from historical and geodetic data (displacement of antropic manufact and geodetic levelling), covering the last 20 years. It suggests that the slip-rates have not changed significantly in the last 1,000 years. The new fault geometry and slip rate data have been used to realise a kinematic and strain model of the PFS, in order to distinguish the vertical and the horizontal slip rate components and to model the tectonic and volcanic strain fields. The calculated tectonic component of the strain can be used to improve earthquake occurrence forecast modelling of this sector of the volcano.