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Transpressive kinematics in active volcanic areas: the case of the Pernicana fault system, Mount Etna (Italy), inferred through geological and geodetic data

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Geological and a structural analysis and ground deformation measurements performed along the eastern portion of the Pernicana fault and its splay segments, integrated with sedimentary basement data, allow the complex kinematics setting of the fault to be defined. The investigated area is dissected by two principal segments of the Pernicana fault: the former showing a N105°-110° orientation cuts the area from Rocca Pignatello (1100 m a.s.l.) to Rocca Campana (800 m a.s.l.); here the fault terminates without morphological evidences. The latter propagates downhill from Rocca Campana with a N120°-125° orientation. Both segments show a clear left-lateral strike-slip displacement. By analysing the position of the fault with respect to the detailed substratum data, it is evident how the abrupt decrease in the volcanic cover thickness conditions the structural setting. At Rocca Pignatello a set of extensional fractures follow a buried drainage gully where the volcanic thickness abruptly increases. The decrease in the volcanic thickness at Rocca Campana forces the fault to branch into a complex system of splay faults. The main N120°-125° oriented fault cuts a prominent culmination of the marly-clay basement. The very thin volcanic cover coupled with the plastic behaviour of the basement, strongly drives and influences the deformation pattern with the development of local short segments affected by different orientation and kinematics. The northern block of the N120°-125° fault is characterised by the development of E-W secondary splay segments showing a transpressive left-lateral displacement. Geological data from Contrada Ragaglia area (520 m a.s.l.) evidenced reverse faults with south-dipping planes, following the local morphology of the basement, that dissect the Ellittico pyroclastic deposits forming a series of fault-bend folds due to the N-S compressive component. A significant component of N-S contraction

on the northern block is also revealed by the rotation of the strain ellipses computed from GPS data. Uniform displacement vectors characterize the southern block of the N105°-110° fault at Rocca Pignatello area, clearly related to a left-lateral kinematics; conversely, the more complex structural framework of Rocca Campana area produces a more complicated ground deformation field. Here, the deformation is partitioned between the N105°-110° and the N120°-125° faults. The whole geological and geodetic data are in agreement to define the kinematics of the eastern propagation of the Pernicana fault system between Vena and Presa villages. In particular, we detected a quite uniform and constant strain field at Rocca Pignatello area, where the fault shows a clear and linear trace and where the volcanic pile reaches a thickness of more than 450 m. Conversely, major change in the kinematics of the fault are detected at Rocca Campana locality, where the structure, N100-105° oriented, branches out into a main segment, N120°-125° oriented. In this area, the kinematics change from purely left-lateral strike-slip to a transpressive left-lateral movement forming a positive flower structure. This abrupt change in the kinematics behaviour of the left-lateral shear zone that dissects the north-eastern flank of Etna is strictly related to the orientation of the N120°-125° fault with respect to the ESE motion of the seaward-sliding unstable sector of the volcano.