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Integration of soil CO_2, seismic and morphological data to detect hidden regional structures in the lower eastern flank of Mt. Etna volcano (Italy)

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The lower eastern flank of Mt. Etna volcano is known for being site of strong diffuse degassing of CO_2, with locally minor emissions of other volcanic gases. The distribution of anomalous CO_2 emissions measured over a large area (about 60 km2) from 1988 to 1989 and from 2001 to 2005 with discrete surveys shows several stable areas of anomalous degassing. Some of these overlap with known tectonic structures, whereas others (the most intense ones) do not apparently correlate spatially with known faults. However, those zones do overlap with areas of greater density of earthquakes recorded between 2000 and 2018 by the local seismic network managed by Istituto Nazionale di Geofisica e Vulcanologia-Osservatorio Etneo mostly at depth between about 6 and 9 km. We integrated the geochemical and seismic data with a new analysis of the morphological features of the study area, that suggest the existence of a larger number of tectonic lines than those mapped so far. The main faults hypothesized in this way follow mainly a NNE-SSW direction, compatible with a deep structural trend at regional scale, possibly linked to the Comiso-Messina lithospheric fault system. Both the hypocentral depth of recent earthquakes and the presence of huge emission of deep CO_2 suggest that the hypothesized faults belong to a crustal volume located between the very deep Africa-related domain of the Hyblean foreland, whose seismicity is mostly located at depth from 15 to 25 km, and the shallower crustal layers belonging both to the Apenninic-Maghrebian belt and to the superimposed volcanics of Mt. Etna. This volume of crust could also host CO_2-rich magma reservoirs forming the deepest parts of the feeding system of Mt. Etna volcano. Therefore, looking at the distribution of the areas where all parameters match together, we were able to better understand the complex structural framework of the lower eastern flank of Mt. Etna volcano and to open new perspectives for the recognition of hidden and potentially active faults in seismogenic and/or volcanic regions.