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Magnetic signatures of subsurface faults on the northern upper flank of Mt Etna

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An high resolution ground magnetic survey was carried out on Piano delle Concazze (PDC) a large flat area, on the northern upper flank of Mt. Etna, dominated by the North Est crater and bounded by the rim of the wide depression of the Valle del Bove. PDC is characterized by North South-trending faults, representing extension-accommodation features linked to the opening of the North-Est Rift, that has been affected by several eruptive events triggered by magmatic intrusion. The field evidence of these North South-trending faults, is sometimes obscured by lava flows and volcaniclastic deposits produced by volcanic activity, by strong erosion and by the collapsed rim of the Valle del Bove. Therefore, the magnetic survey, covering an area of about 0.2 km2, was aimed to better identify the main structures affecting this area and elucidate their relationships. Magnetic data were acquired by a GSM19 Overhauser effect magnetometer with 0.01 nT resolution, more than 2,500 measurements were gathered with a sampling step of about 3 m along lines describing an irregular grid with sides close to 100 m. The total-intensity anomaly field, obtained after data reduction process, reveals intense maxima South-North aligned in the middle part of the investigated area and along the Valle del Bove rim related to shallow and deep geological structures affecting this area. Filtering techniques based on the derivatives of the magnetic data has been applied for the determination of the magnetic source parameters such as locations of boundaries and depths. In particular, in order to distinguish the near surface structure, filters of the vertical derivatives, Butterworth high-pass, analytic signal amplitude, and total horizontal derivative of the tilt derivative were used. The 3D Euler deconvolution has been used to estimate the depth and the structure indices of the causative targets.
Our total field magnetic anomaly survey shows that characteristic magnetic anomalies are related to fault zones in the PDC, and that subsurface structures can be investigated and modeled allowing to identify structures that can be activated by magma intrusions. Our findings provide new constraints to be used in aiding volcanic and seismic hazard assessments in this area that despite being deserted is among the most popular tourist destinations throughout the year.