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Moving through different structural styles: kinematics and sediment discharge of the Mount Pizzuto earth flow, southern Italy

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Surface mapping, GPS surveys, T-LiDAR surveys, boreholes, seismic profiles, and HVSR measurements are used to study the geometry, kinematics, segmentation, and sediment discharge of the Mount Pizzuto earth flow in southern Italy. This earth flow is one of the most active earth flows of the Benevento Province (southern Italy), causing direct damages to properties and indirect damages to the local road and service lines, which have been destroyed several times by the earth flow induced floods. It involves an estimated volume of 300,000 m3 of fine-grained flyschoid material, and has a complex source area with two branches, a ∼500 m long transport zone, and a fan-shaped bulging toe.

The earth flow presents several kinematic zones, with transitional areas marked by a change of deformational style, from compressional structures (thrusts) upslope to extensional structures (normal faults) downslope. We use displacement/velocity data and the reconstructed cross-sectional geometry to calculate sediment discharge at the transition of the kinematic zones relating it to internal strain. This allows us to understand i) the characteristics of flow movement, ii) the control exerted by the basal slip surface on flow velocity, iii) changes and distribution of flow velocity, and iv) characteristics of sediment transport along the flow and cascade effects during both ordinary and extraordinary (i.e. surge) movements.

The results suggest that: i) during surge, flow acceleration starts within the head and propagates downslope (constant sediment discharge) inducing a cascade effect between kinematic zones, ii) change in mechanical behavior of the material below the neck influences the propagation of movement downslope, iii) during ordinary movement, the activity of kinematic zones is mutually independent and sediment discharge varies along the flow length, iv) the velocity profile and the dilatation style are controlled by the geometry of the basal slip surface, and v) the earth flow changes volume moving through a kinematic zone and such change depends on the earth flow velocity.

Implications are that: i) earth flows having a well-defined neck are more likely to surge with respect to those without, ii) sediment discharge is not constant but is a function of the earth flow activity, iii) during a surge, earth flow material behaves similar to an incompressible fluid and, iv) the distribution of structures at the flow surface can provide information about the geometry of the slip surface and the velocity profile.

These observations are important for establishing the contribution of the Mount Pizzuto earth flow and other earth flows in the region to the river network, and their impact on the geomorphological evolution of the area.