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Implication of earthquake-induced and tectonic erosion for landscape evolution. An example from the southern Apennines

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Text of Abstract

Earthquake can contribute to long term erosion in mountain belts by triggering landslides or lowering the topographic surface and therefore producing "tectonic erosion" (i.e. tectonic exhumation or denudation).

Recently, erosion as been recognized as first order factor in mountain building (Pinter & Brandon, 1997). Several studies have shown how spatial and temporal variation of erosion rates can induce uplift and so control the landscape evolution of the entire belt.

Erosion due to linear incision by the drainage network has been quantified in few orogens at different time scales and with different methods as main factor that produce and limit relief although results are sometimes in contrast and show that more insight is needed to fully understand the complex relationship between tectonic, climatic, and erosion processes (Molnar, 2004, Dadson et al., 2004). Moreover very few studies have considered the contribution to long-term erosion of earthquake-triggered landslides and of tectonic erosion.

Genesis of huge landslides triggered by seismic events as a punctual response to the Quaternary tectonic uplift is one of the basic denudation processes of the southern Apennines erosion history (see for example Capolongo et al., 2002).

It is well-known, in fact, that the potential of relief of this chain is improved during Pleistocene times by normal faulting coupled with thermal/isostatic regional raising

(Schiattarella et al., 2003; Boenzi et al., 2004) and by strike-slip and/or oblique-slip faulting acting in an earlier deformational stage (i.e. during late Pliocene – early Pleistocene; see Schiattarella, 1998, and references therein).

Yet, another exhumation mechanism has to be taken into account to explain the gap of several km of the eroded section, as suggested by comparison between uplift rates and tectonic loading values (Schiattarella et al., 2003). As a matter of fact, starting from late Miocene, a conservative denudation value of about 4-5 km has to be reached. Tectonic erosion by low-angle detachment and extension of the upper parts of stratigraphic successions and/or tectonic stack may be taken into account for a reliable explanation of this discrepancy. Such phenomena led to the exhumation of the Mesozoic core of the chain, causing low-angle extension on its Tyrrhenian side by re-activation and inversion of older thrusts, and stacking on its eastern margin of Cretaceous to Miocene pelagic and flysch units (i.e. frontal embricate fan units) by gravity megasliding.

We suggest here that tectonic erosion, deep gravitational sliding and earthquake-induced landsliding could represent a temporal and spatial evolution, on a different scale, of linked tectonic and geomorphological processes and is a first order factor to control the landscape evolution of the southern Apennines.

Two different approaches provided estimates of the long term erosion rates due to earthquake-induced landslides and tectonic erosion.