Geophysical Research Abstracts
Vol. 14, EGU2012-7786, 2012
EGU General Assembly 2012

Tectonic control on extensional basins infill and on rivers incision. Examples from the Northern Apennines of Italy

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In extending areas undergoing a regional tectonic uplift, the persistence of subsidence at the normal faults hanging-wall depends on the competition between the regional and the local tectonic effects. When the regional uplift exceeds the normal faults hanging-wall subsidence, denudation prevails. When the hanging-wall subsidence exceeds the regional uplift, the hanging-wall can be filled by sediments supplied by catchments eroding the uplifting foot-wall. The unraveling of both the Quaternary infill history and of the rivers incision in extensional basins can provide insights on the recent to present day activity of the basins bounding faults.
We investigate this topic in the Northern Apennines of Italy. The area is characterized by the interaction of three morphogenetic processes affecting the rivers incision: a regional uplift in the order of 0.5 mm/yr; climatic/eustatic changes and active tectonics.
Our work is focussed within three extensional basins presently connected by the Tiber river. The basins rest at the hanging-wall of a low-angle NE-dipping normal fault. The fault has been active since the lower Quaternary and is presently active at 2.5 mm/yr extension rates.
We performed detailed field surveys, seismic profiles interpretation, aerial-photographs checks and analysis of the main rivers longitudinal profiles in order to unravel the efficiency of the basins bounding faults in maintaining the hanging-wall subsidence.
We find an overall continuity in the tectono-sedimentary evolution of the three basins. This is shown by the outcropping faults affecting the continental deposits, by the infill geometry as shown by seismic reflection profiles across the basins and by the landscape and rivers response to tectonic forcing in terms of morphological indicators and rivers disequilibrium.
On the other hand we identify a major difference in the subsidence of the three basins. This is shown by the Tiber river incision which is not homogeneous and varies downstream as it crosses the three basins. The northwestern basin is pretty flat with little or no incision, while the southeastern basins are characterized by two orders of well-recognizable fluvial terraces resting on top of the Quaternary deposits up to 40 m with respect to the present alluvial plain.
On the basis of our study we interpret the along strike changes of the Tiber river incision as the result of the competition between the regional uplift and the local extensional tectonics. Within this competition, the northwestern sub-basin appears to be dominated by local subsidence. This is due to the fact that the basin bounding normal faults are vigorously active and the hanging-wall subsidence overcomes the regional uplift. On the other hand within the southeastern sub-basins, uplift dominates on the foot-wall subsidence promoting river incision. These inferences coincide with the distribution of the historical seismicity which is silent in the southern part with respect to the northern part.
Our results suggest that a detailed investigation of both the tectono-sedimentary history of extensional basins and of the rivers incision pattern is very fruitful in the identification of tectonically active structures.