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Ground rupturing in Mavropigi, northern Greece due to mining and active tectonics

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During summer 2010 a set of surface ruptures has been observed deforming the area of Mavropigi, located west of one of the main lignite mining areas of Ptolemais basin, northern Greece. A significant number of houses in the village of Mavropigi have sustained damages due to the propagation of the fracture lines. This set of fractures is since constantly developing and forms two main lines consisting of continuous or predominantly en échelon cracks with varying amount of normal vertical displacement. Since this is an ongoing phenomenon, the displacement is constantly increasing, but it generally ranges between a few mm and 20 cm. Dip direction is almost invariably towards the NE, while small rupture bounded depressions are abundant; in certain cases, a small left-lateral component is also evident. The general strike of the lines is NW-SE, roughly coinciding with the pre-existing marginal normal fault at the area, which generally marks the contact between the basement rocks (Paleozoic gneiss overlain by M. Triassic – L. Liassic limestone) and the filling of the basin (L. Pliocene – Pleistocene lignite-bearing lake and fluvial sediments). Measurements of the displacement vectors along the fracture lines show that they coincide almost exactly with the NNE-SSW trending extensional axis of the local stress field.
The tectonic regime of the broader area is under consideration and revision, as although the entire basin is deformed by normal synsedimentary faults, in certain cases coeval reverse faulting is evident and interacting with the extensional structural features.
Finite element analysis of the deformation taking into account the already mined volume of rock, shows that the main driving force for the formation of ruptures is the intensive mining by the Public Power Corporation S.A., which has formed a very steep and high staircased scarp, roughly parallel to the geological fault and the fractures. Although the surface deformation lines are rather straightforward, the small-scale complexity suggests that the deformation pattern is a combination of two factors, the main one being intensive lignite mining and the resulting relaxation, with the effect of the local stress field.