



Surface deformation due to over-exploitation of subsurface natural resources. Study case: Petrosani mining area, Romania

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The Petrosani basin in the South Carpathians area of Romania is a well-known example of an over-exploited coal mining zone. In recent times, most mines have been closed, but an extensive and dense network of galleries still exists. Most of the abandoned ones were not filled in with mine tailings. There is strong concern and evidence that the old galleries are collapsing and/or filling up with water, leading to significant surface deformation and potential hazards, especially for the local communities.

The aim of this study is to characterize the present surface motions using GPS measurements. We focus on the Maleia mining sector, east of the city of Petrosani. For this purpose, a network of 19 surface markers in and around the mining zone was established in 2006 to enable both leveling and GPS measurements. This was a difficult effort because of the limited infrastructure in the region, the local topography, the complex geometry of the galleries and the wish to cover assumed stable as well as unstable sectors.

GPS data were recorded from all markers during the period 2007-2012 (excluding 2010). The measurements were collected in short campaigns of 1 to 2 days per year, with observation periods of 2 to 4 hours per marker and at a 30s sampling rate. The data were processed with the Gipsy software, using the "precise point positioning" (PPP) strategy.

The results are quite consistent and show significant horizontal and vertical surface motions. The horizontal velocities range from 0 to 30 cm/yr (mainly in WSW direction) whilst the vertical velocities range from +4 (uplift) to -25 (subsidence) cm/yr. The largest motions are clearly associated with the central (oldest) sector of the mining area. The pattern of vertical motions suggests that the peripheral area is uplifting in response to the subsidence of the central sector.

We conclude that the collapsing mines in the Petrosani basin create a very dynamic surface motion environment, which represents a serious hazard. We recommend monitoring of the area with continuous GPS measurements to identify episodic changes in the surface motions. This will enable a better understanding of the dynamics and allow improved predictions of the future surface motions and the associated hazards in this area.