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Registration of dynamics of surface changes in the Upper Silesia (SW Poland) using Persistent Scatterer Interferometry

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The Polish Geological Institute (PGI) as a member of TerraFirma Consortium obtained PSI datasets for the Sosnowiec area (Upper Silesia Coal Basin) in mid-March 2004 and Rybnik - Ostrava area in May 2007. The area of datasets covers most of the Upper Silesian Coal Basin at the territory of Poland and part of the coal basin at the territory of the Czech Republic (Ostrava - Karvina region). Processing of the data has covered scenes both ERS-1, ERS-2 and Envisat registered between 1992 and 2006. The PSI data were processed by two companies; TRE and Gamma Remote Sensing. The most interesting results obtained in the Sosnowiec area included: The indicated subsidence values in the period from1992 to 2003 vary between -39.63 mm to +25.12 mm. These values seem improbable, because greater changes (even up to few meters) were indicated by precise leveling. These values show rather the tendencies of the slow ground motion with a very high accuracy. There is a distinct difference between the northern (relatively stable) and southern (unstable) areas. This is probably related to the mining activity in the Upper Silesia. Mining activity in the northern area, including Sosnowiec city, practically ceased. In the southern area, the coal is still being mined. Preliminary interpretation of the PSI data of the Upper Silesian Basin indicated strong correlation between the recorded PS negative values and structural pattern of the Carboniferous strata. The results indicate that the subsidence is present at the areas of the synclinal structures such as Bytom Basin, northern slopes of the Main Basin and the Little Zaborska Basin (near Zabrze). The clearly visible concentration of the negative values is also noted at hinges and dropped wings of the Bedzin and Klodnica regional faults. Undoubtedly, the two above mentioned faults of the Variscan origin were rejuvenated

during the Alpine Orogeny (the Triassic deposits were found in the dropped wings of the faults). The presence of the ground motion along its run, can suggest neotectonic character of these faults. Linear anomalies oriented WNW - ESE formed by changing values of the ground motions are parallel also to the productive Carboniferous sediments forming the coal basin - Karwiñskie Upper Layers, Ostrawskie Layers and Karwiñskie Lower Layers. The explanation of these phenomena (genesis and mechanisms) needs further studies. There is an evident correlation between linear negative anomalies and induced seismicity, mainly in the vicinity of the Klodnica fault. Interpretation at the Rybnik - Ostrava scene, started from the Jastrzæbie Zdrój town. It is located in the southern part of the Silesian Voivodeship close to the Czech border. The area of the town covers about 85.4 km^2. The hard coal mine exploitation takes place within the town agglomeration, since 1960. Four coal mines are under operation: KWK “Zofiówka”, KWK Jas-Mos, KWK Moszczenica, KWK Borynia. The mining activity has strong and negative impact at the surrounding environment. The following phenomena were noticed: Relief changes, leading to the development of depressions without out- flow. Inundations etc. Development of the surface water basins, due to subsidence, related to mining operations. Rate of the subsidence, since the beginning of the mining operations results from 0.5 up to 8 meteres Changes of the profiles of the running water. Soil degradation leading to unfavorable changes of the vegetation growth. Hazards related to pollution of groundwater. Induced seismic shocks and material looses due to rock bursts. The six PS localities which showed maximum subsidence at the rate 10 mm/year, were selected in the Jastrzæbie Zdrój region and checked during field reconnaissance. Preliminary results indicated the following regularities: The correlation between “negative” PS and objects showing small amplitude of motion - 1 cm/year was confirmed. The most probable reason of that motions is creeping (at the slopes of the subsidence basins), indirectly related to mining activity. The positive correlations were founded at the areas above the bottom pillar. The areas characterized by much bigger amplitude of motions related to mining exploitation as well as rock bursts were not indicated at the interferometric data. The presented case studies and have indicated, that the geological application of PSI can be very useful tool for monitoring slow ground motions in relation to subsurface mining , tectonic movements and landslides.