Contaminated sediments as a potential source of heavy metals in the Upper Vistula River and historical mining and smelting area of South Poland

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Numerous hard coal exploitation n and processing and metal-ores mining and metallurgy centers were operated in the Upper Silesia region in Poland until the end of the XXth century and at present as well. As a result of this activity following environmental hazards happened: large amount of contaminated mining waters has been discharged into the Upper Vistula and Odra Rivers and huge amount of wastes i.e. overburden stripping rocks, flotation wastes, slugs and ashes from smelters were deposited in the vicinity of the mines and smelters. This investigation focuses on environmental effects on the surrounding environment. Additional environmental impact have been originate from the power stations located close to the coal mines. The metalliferous ore mining and smelting have been the main sources of heavy metal contaminations over the last 100-180 years. The historical and present impact of mining could be explained on the river bottom sediments and depth profiles from the specially places, e.g. on the river bank or bar. The metal concentration in the sediment depth profiles from the flooded terrace or river bank give the best information for their historical and present accumulation. Previous study [1] revealed very high concentration (mg/kg) of Zn (up to 11 000), Pb (1700) and Cd (up to 150) in the overbank alluvial sediments of the Upper Vistula and sediment profile of the Przemsza river, the Vistula tributary.

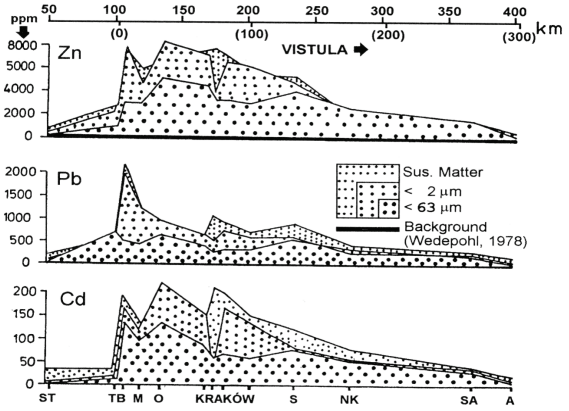

Fig. 1: Distribution of Zn, Pb and Cd in the PSM, and sediments of the Upper Vistula River [2].

The concentration of metals in the Vistula River sediments in Krakow was very high especially for Cd up to 140, Pb 760 and Zn 5300 ppm. A decrease of the metals content in the Vistula River sediments downstream of Krakow is considerable (**Fig. 1)**.

In the Upper Silesia area the main sources of metals are mining and smelting of Zn and Pb in the Bukowno - Olkusz and Bytom regions. Previous study [3] showed that soils in the vicinity of a Zn-smelter in Bukowno contained high concentration (mg/kg) of Zn, Pb, Cd, Tl and As: 234-12 400; 42-3570; 25-133; 3.1-146; 25-133, respectively. However, recent results for soils from the vicinity of flotation pond in Bukowno showed considerable lower concentration (mg/kg): Zn: 490-4400, Pb: 120-1600, Cd: 4-170, Tl: 0.4-2.9, As: 7-39. Although in Bytom region the ore mines (worked since 12th century) have been inactive since 1989, the soils were strongly polluted with heavy metals [4]. An example of Pb showed **Fig. 2**.

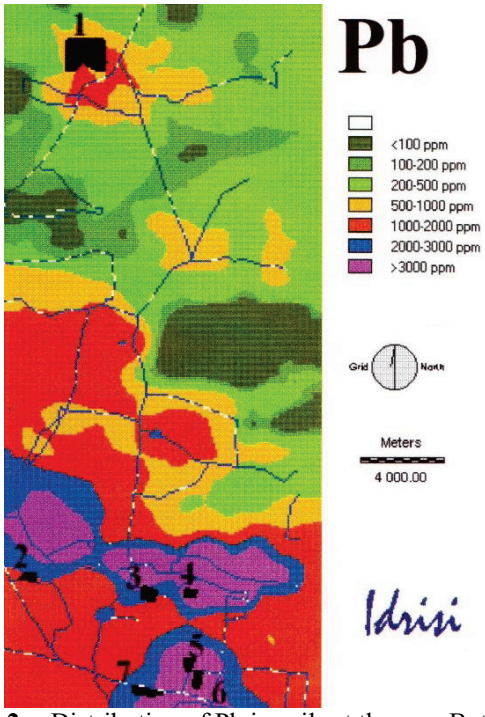

Fig. 2: Distribution of Pb in soils at the area Bytom-Miasteczko Śl., Upper Silesia [5]. 1 Miasteczko Śl., 2 Bytom Zn-smelters, 4 Warynski Mine, 3, 7 closed mines, 5 closed Zn/Pb smelter, 6 closed mine.

References: [1] Macklin, Klimek (1992) *Appl. Geog.* **12**, 7-30. [2] Helios-Rybicka (1996) *Env. Geochem. & Health*. **113**, 183-193. [3] Verner et al. (1996) *Appl. Geochem*. **11**, 11-16. [4] Ulrich et al., (1999) Appl. Geochem. **14**, 187-196. [5] Helios-Rybicka, Mider (munuscript in preparation).