Mercury enrichments in Slovenian soils

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Abstract: Investigations that last for more than a decade yield important information on the distribution of mercury in the soils of Slovenia. Low mercury contents of natural origin are found in the area of north-eastern Slovenia, while relatively high values, originating in natural enrichment, are shown in the south-western part of Slovenia. Strong mercury anomalies are a consequence either of mining and smelting in the area around Idrija or black metallurgy in the area around Jesenice. The increase of mercury contents in the areas of Celje and Mežica is due to Pb-Zn mining and smelting, while in the area of Ljubljana it is due to heating stations, industry and street traffic.

Key words: mining, smelting, traffic, ironwork, mercury enrichment

INTRODUCTION

The first systematic regional investigations of Hg concentrations in Slovenian soils began in previous decade. They were based on random sampling, which enabled a quantitative estimation of mercury distribution in the entire Slovenian territory with relatively small number of samples. The investigations continued through an entire decade. Current map of Hg distribution in the soils in Slovenia comprises 1520 analyses of topsoil samples, which were collected within an irregular mesh but according to a uniform methodology. In the Slovenian countryside, where towns are small and industry is scarce, we used relatively thin sample mesh (PIRC, 1993), where we expected only natural Hg distribution. The mesh was thickened in the areas where we expected higher contents of mostly anthropogenic Hg. The investigations included narrow mining and smelting areas (Idrija, Jesenice, Mežica, Celje) and larger towns (Ljubljana, Maribor, Celje).

RESULTS AND DISCUSSION

The distributions of mercury in soils show strong anomaly in the western part of Slovenia. The mentioned sample of mercury distribution indicates regional impacts of the ore deposit, mine and smelter in Idrija or black metallurgy in the Jesenice. Low Hg contents of natural origin are found in the north-eastern part of Slovenia (Fig. 1).

Five hundred years of intensive mercury mining activity in Idrija left a legacy of highly polluted soils and sediments. The mercury dispersion halo has been formed in a wide circle around Idrija. It is partly geogenic, but mostly technogenic. Its extension and characteristics were established on the basis of the Hg concentrations in soil in a local and regional scale (GOSAR & ŠAJN, 2003). By sampling in an area of 160 km^2 around the Idrija mine it was established that mercury concentrations in soil exceed the critical values for soil (10 mg/kg) on 19 km^2

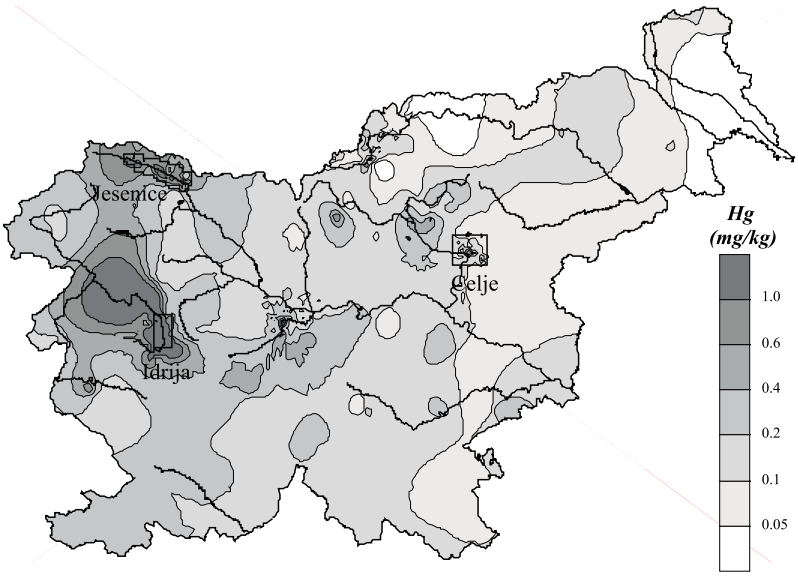

Figure 1. Areal distribution of mercury in Slovenian soil.

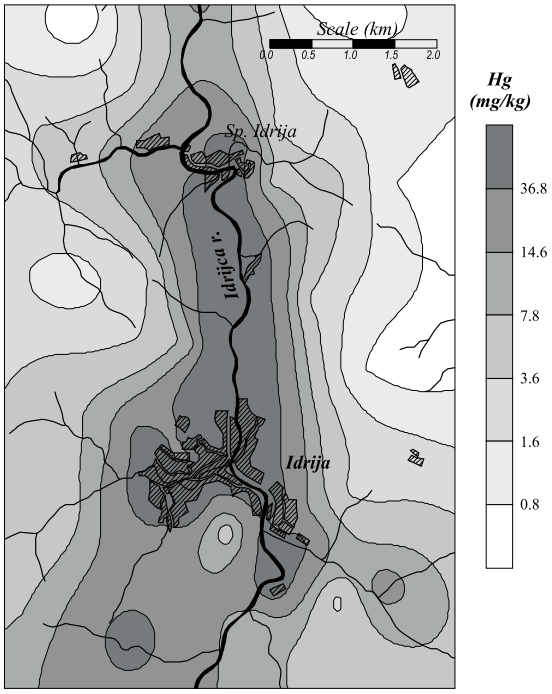

Figure 2. Distribution of mercury in topsoil around Idrija.

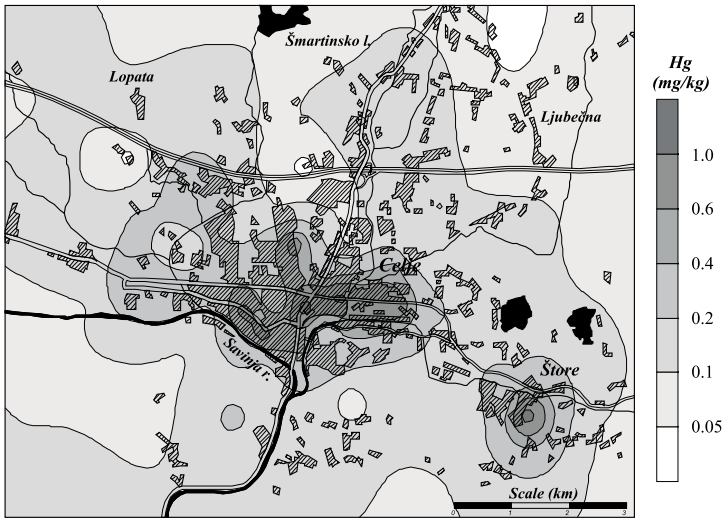

Figure 3. Distribution of mercury in topsoil in Celje area

(GOSAR & ŠAJN, 2003). Smelting process produced gaseous and particulate matter emissions, which were the major cause of creating a huge geochemical halo around Idrija mercury mine (Fig. 2).

In the area of Celje, a town with about 50.000 inhabitants (Fig. 3), we found high contents of mercury in topsoil, the source of which was the smelting of zinc ore between the years 1873 and 1970. The average Hg content in the town centre (0.26 mg/kg) is more than 2 times above the average content in area around Celje (0.11 mg/kg) (ŠAJN, 2001).

In the area of Jesenice, a town with about 20.000 inhabitants, we investigated the impact of centuries long lasting iron-working activities in a narrow alpine valley (Fig. 4). Anthropogenic enrichment of mercury in the upper horizon of soils was identified. In the area around Jesenice, the average content of mercury (0.80 mg/kg) is 5 times above the Slovenian average (0.16 mg/kg) (ŠAJN ET AL., 1999).

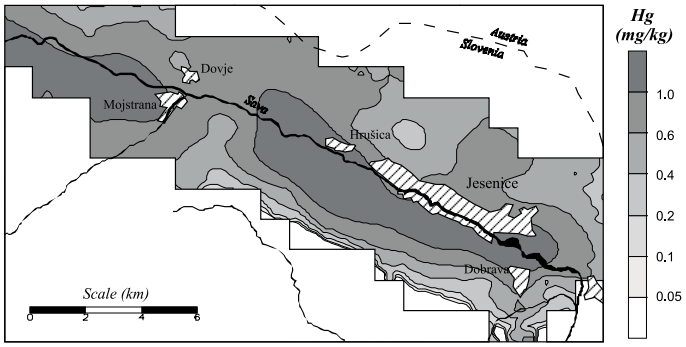

Figure 4. Distribution of mercury in topsoil in Jesenice area.

In the Mežica valley, 300 years long lasting mining and smelting of lead and zinc ore had a very negative impact on the environment (ŠAJN, 2002). In contrast to the distributions of other heavy metals, higher Hg concentrations were determined only in the vicinity of the smelter.

In Ljubljana we studied the pollution of soils originating from traffic, industry and households. The study covered an area of 168 km^2. The average for soils in the Ljubljana environs is 0.22 mg/kg Hg, in the city centre 0.25 mg/kg. The Hg content in forest soils, 0.36 mg/kg Hg, is more than 2 times above the Slovenian average (ŠAJN ET AL., 1998). This suggests the deposition mechanism of atmospheric particles on the foliage of trees, and enrichment in the forest soils. The impact is the highest in downtown Ljubljana with many high Hg values. Several samples with high Hg concentrations were collected near the Ljubljanica River. Hg anomaly was also found at the site of an ancient municipal waste disposal site. Individual high values near arterial roads indicate that the source of a part of mercury is traffic.

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