

Mercury Distribution in Soils and Effect of Forest Fire on its Pools in forest ecosystem, Czech Republic



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INTRODUCTION

Mercury (Hg) is a toxic trace metal with the potential to bioaccumulate. It is therefore important to determine fluxes and pools of Hg in ecosystems as well as its natural and anthropogenic sources. Major **anthropogenic sources** of Hg to the atmosphere were studied, monitored and quantified but the **natural sources** of Hg emissions to the atmosphere were not as well characterized. Recent studies indicate that **wildfires** may provide a significant flux of Hg from terrestrial ecosystems to the atmosphere. During the forest fires previously deposited Hg is released primarily from the **biomass and organic-rich soil horizons** to the atmosphere.

This study investigated effect of **forest fire on soil Hg pools** in forest located in central Europe, Czech Republic. Large forest fire burned the standing biomass and vast majority of organic soil horizons on area of **17.9 ha** at the **Bohemian Switzerland National Park** in July of 2006. The fire resisted in a hardly accessible area for one week.

SITE DESCRIPTION

The Bohemian Switzerland National Park was established 1st January, 2000 in northern tip of the Czech Republic. It stretches on area of 79km² and belongs to unit of Bohemian Cretaceous Basin. The bedrock is formed predominantly by quartz sandstones of Cenomanian to Turonian age. The long-term mean annual temperature is about 7°C and mean annual precipitation height 800mm. Studied area impacted by the forest fire covers 17.9ha and is found in altitude from 300 to 430 m.a.s.l. The soils in area were described as Albic Podzols and Podzols (WRB classification).

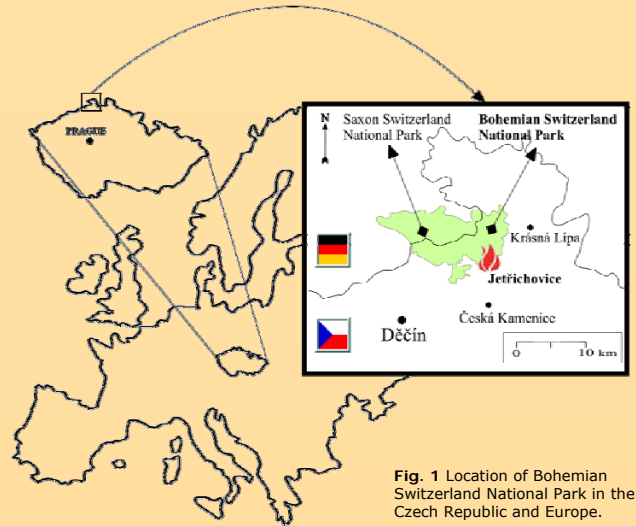


Fig. 1 Location of Bohemian Switzerland National Park in the Czech Republic and Europe.

Albic Podzol

	P kg m ⁻²	C %	S %	Fe ox. mg kg ⁻¹	exch. H ⁺ meq kg ⁻¹	Hg µg kg ⁻¹
Ol						
Of	0.190	32.7	0.18	4524	1046	333
Oh						
A	1.310	2.1	0.05	4423	145	41
E	1.450	1.9	0.03	3245	94	16
Bhs	1.110	3.2	0.02	7570	267	42
Bs	1.110	1.1	0.03	11980	160	39
C	1.150	0.3	<0.02	2635	69	8

Figure 3 Typical layout of the soil horizons.

Table 1 Mean physicochemical parameters for individual soil horizons.

	n	42		12		30	
		ALL soils		ORGANIC		MINERAL	
		Hg		Hg		Hg	
pH		-0.506		-0.929 *		0.056	
exch. H ⁺		0.942 **		0.861 **		0.802 **	
CEC (cation exchange capacity)		0.899 **		0.762 *		0.851 **	
TN (total nitrogen)		0.657 **		-0.410		0.493	
TOC (total organic carbon)		0.805 **		-0.223		0.795 **	
TS (total sulfur)		0.824 **		0.631		-0.168	
Al _o (oxalate-extractable Al)		0.091		0.839 *		0.337	
Fe _o (oxalate-extractable Fe)		0.195		0.813 *		0.548 **	
Mn _o (oxalate-extractable Mn)		0.056		-0.602		0.007	

** statistically significant at p < 0.001
 * statistically significant at p < 0.1

Table 2 Pearson correlation coefficients between Hg concentration and physicochemical parameters for all soil samples (n=42), organic (n=12) and mineral soils (n=30).

Calculation

The total Hg emissions originating from the forest fire covering 17.9 ha at the Bohemian Switzerland National Park in year 2006 reached 1.26 kg. Total amount of forest fires in the Czech Republic reached up to 679 in year 2006 and the damaged area covered 405 ha. From previous research by others (Suchara, Sucharová 2000) we know concentrations of Hg in organic horizons of the Bohemian Switzerland National Park were similar to mean values for whole country. Thus we estimate Hg emissions on area of the Czech Republic from this natural source to reach 47.5 kg in year 2006.

CONCLUSIONS

The concentrations of Hg in organic and mineral horizons of the Bohemian Switzerland National Park differed by two orders of magnitude. The organic and mineral pools on the other hand were of a similar significance. Forest fires thus may decrease the soil Hg pools by as much as 50%.



Fig. 2a,b The forest fire lasted one week and it burned vast majority of the organic soil horizons on area of 17.9 ha.

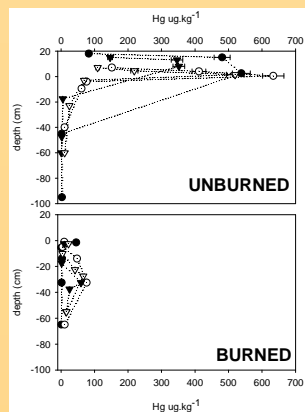


Fig. 4 Hg concentration throughout the soils profiles at unburned and burned plots. Four profiles were sampled at each type of plot.

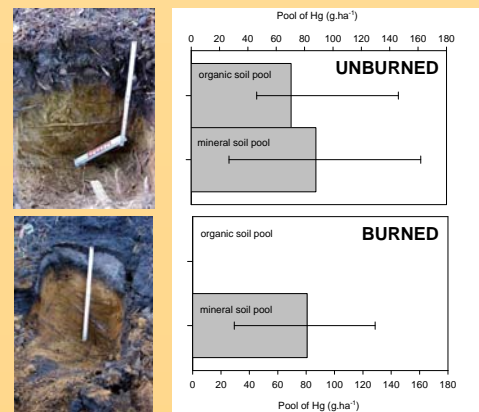


Fig. 5 Calculated Hg pools on unburned and burned plots. Bars indicate mean, error bars indicate minimum and maximum pools.

