MAIN SOURCE AND SINK OF MERCURY IN A CATCHMENT OF WANSHAN Hg MINING AREA, GUIZHOU

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Introduction

Wanshan Hg mining area is the third reserve and production of Hg in the world. A history of about 3000 years of Hg mining activities has been experienced in Wanshan Hg mining area. Although large-scale state owned Hg mining activities were completely shut down in 2004, Hg pollutions are still serious in local environments. The concentrations of total mercury (THg) ranged 0.10 - 790 mg kg^{-1} in soil (Qiu etal., 2008), 2.91-12,000 ng L^{-1} in surface water (Zhang et al., 2010b), 17.8-1101.8 ng m^{-3} in ambient air and with the Hg emission flux of 162 - 27827 ng m^{-2} h^{-1} from soil to the air (Wang etal., 2007). Hg in ambient air can be scavenged via wet and dry deposition. More than 90% of the continental deposition of Hg occurs on soils, then this part of Hg will be transported to aquatic environments through soil erosion, surface runoff and lixiviation of deeper soil horizons. Researching on the sources and sinks of Hg could help us to understand the cycling of Hg among atmosphere, soil and aquatic systems. Seriously polluted part of Hg pollution in ecosystem will be confirmed.

Methods

Sampling of precipitation and throughfall for a full year (May 2010 to May 2011) were conducted on a weekly basis at three sites (Shenchong, Dashuixi, and Supeng) to calculate Hg deposition fluxes. Besides, we sampled 14 typical soil profiles to analyze the spatial and vertical distributions of Hg in soil in the study area. And then, revised universal soil loss equation (RUSLE) and geographic information system (GIS) methods were applied to calculate soil and Hg erosion and to classify soil erosion intensity.

Results

The mass balance of Hg in a catchment of Wanshan Hg mining area is in Figure 1. Our work indicated there were 1526 tons THg in soil, and 1282 tons of them were induced by human activities. It's remarkable that most of Hg in soil belonged to farmland (1300 tons), and the Hg induced by human activities was up to 1227 tons. Hg surface erosion load was predicted to be 505 kg yr^{-1} and the corresponding mean migration flux of Hg was estimated to be 3.02 kg km^{-2} yr^{-1}. There were different erosion load in different land uses(meadow soil > dryland > bare soil > forest soil > paddy soil). With the increase of slope, greater erosive power was considered to cause stronger Hg migration capability. When the slopes exceed 50°, the Hg load induced by soil erosion was up to 502.7 kg yr^{-1}. In the study region, the annual wet and dry deposition of Hg^0 could be up to 21.6 and 167.5 kg respectively. Dry deposition played a dominant role in total atmospheric Hg deposition in Wanshan Hg mining area since the dry deposition fluxes were 10.4-37.9 times higher than the wet deposition fluxes during the whole sample period. Based on HEC-HMS and WASP, 10.28 kg of Hg were released to water from mine wastes. And 6.88 kg of Hg will deposit to river bed every year in two rivers, and the total discharge of Hg in river were 3.4 kg yr^{-1}.

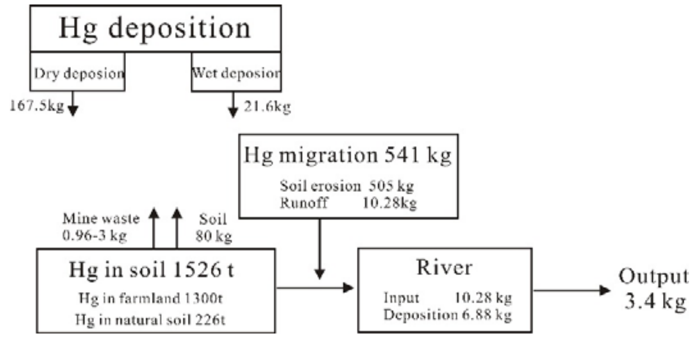

Figure 1. Mass balance of Hg in a catchment of Wanshan

Conclusion

Soil was both the potential source and sink of Hg in the cycling of Hg. Especially, farmland was the most seriously accumulated Hg comparing to other details of ecosystem, whereas, it had no capability of self-purification. As one of the basic qualities for human existence, farmland, which was suffering such heavily Hg contamination, caused environment contamination even worse. Moreover, mine waste was the proximate source for most Hg in aquatic systems, especially for downstream rivers.

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