

Li Shehong  
Zheng Baoshan  
Zhu Jianming  
Yu Xiaoying

## The distribution and natural degradation of cyanide in goldmine tailings and polluted soil in arid and semiarid areas

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L. Shehong (✉) · Z. Baoshan  
Z. Jianming · Y. Xiaoying  
State Key Laboratory of Environmental  
Geochemistry, Institute of Geochemistry,  
Chinese Academy of Sciences, Guiyang,  
550002, Peoples' Republic of China  
E-mail: lisheshong@mail.gyig.ac.cn  
Tel.: +86-851-5891373  
Fax: +86-851-5891609

**Abstract** Farmlands and rivers have been seriously polluted by cyanide from a goldmine tailings dam that collapsed in early spring of 1995 in Yining County, Xinjiang Autonomous Region of China. The cyanide distribution in the polluted farmland and the abandoned tailings dam was studied, three and 4 years after the accident occurred. The results indicated that natural degradation of cyanide in soils is slower than in natural water bodies. The cyanide transport in the soil section is similar to freely soluble salts. In arid and semiarid areas, cyanide can be highly enriched in the salt crust in which the

concentration is even higher than the fresh tailings debris though cyanide has decomposed for 4 years. In the polluted farmland, the sticky layer in the soil section can highly adsorb and enrich cyanide so it can partly prevent cyanide transfer to groundwater. According to the characteristics of cyanide natural degradation in soil, the measures for prevention and cure of soil polluted by goldmine tailing dam collapse have been discussed.

**Keywords** Goldmine tailings · Cyanide distribution · Soil pollution · Arid and semiarid areas · China

### Introduction

Cyanide ( $\text{CN}^-$ ) is hypertoxic to humans and many other living creatures (Boening et al. 1999). In many goldmine enterprises 0.05–0.1% of sodium cyanide solution is used to extract gold from ore in tank operations (US EPA 1994). The tailings slurry usually contains a high concentration of cyanide. The release of  $\text{CN}^-$  can be a serious hazard to the environment. A recent serious episode was the cyanide pollution of the Danube and Tisza rivers because of the collapse of goldmine tailings dams in Romania in early 2000. The study area described also occurred in a goldmine tailings dam collapse event. Many studies show that cyanide can decompose in the natural environment and the natural degradation rate is controlled by many conditions (Meeussen et al. 1992; Boucabeille et al. 1994; Kjeldsen 1999). According to the authors' former study, the toxicity in rivers polluted by cyanide wastewater is temporary and acute (Li Shehong

et al. 2005). The natural degradation of cyanide in polluted soils and abandoned tailings dams is more complex and slower than in water. Till now there are few papers dealing with the study of the natural degradation of cyanide in polluted soils and abandoned tailings debris in the arid and semiarid area of China.

The purpose of this article is to study the long-term impact on soils by accidental discharge of cyanide from a goldmine tailings dam that collapsed, and the natural degradation of cyanide in polluted soils and abandoned tailings dams under arid and semiarid climatic conditions.

### Materials and methods

#### Study area and sampling

The study area of Tawurbiek goldmine is in the north-east, about 25 km of Yining City in Xinjiang Autono-