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ORIGINAL ARTICLE

Analyses of the vertical and temporal distribution of sulfate-reducing bacteria in Lake Aha (China)

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Abstract In April and September of 2005, two sediment cores were collected from Lake Aha, which is polluted by the acid mine drainage of the mining industries. Sulfate-reducing bacteria (SRB) groups and their quantity were analyzed by using PCR and FISH (fluorescence in situ hybridization), respectively. The results showed that four SRB groups (*Desulfotomaculum, Desulfobulbus, Desulfococcus–Desulfonema–Desulfosarcina* and *Desulfovibrio–Desulfomicrobium*) were detected in September, while only three SRB groups (*Desulfotomaculum, Desulfobulbus* and *Desulfococcus–Desulfonema–Desulfosarcina*) were detected in April. *Desulfovibrio–Desulfomicrobium* was not detected and was expected to exist inactively, in April. Meanwhile, the distribution of every SRB group was wider in September than in April. The results indicated that different SRB groups had different vertical and temporal distribution. The vertical and temporal distribution of SRB was mainly in the upper sediments, and the number of SRB groups and quantity were larger in September than in April. It suggested that the environmental conditions of sediments in September were more suitable for SRB.

Keywords Sulfate-reducing bacteria · Vertical and temporal distribution, SRB groups and quantity · PCR · FISH

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Introduction

One of the most serious environmental problems created by the mining industry is acid mine drainage. The problem is a matter of concern in Lake Aha, Guizhou Province, China.

This problem first came to the attention of scientists in the 1990s. As acid mine water containing the sulfate from hundreds of coalmines flowed into the lake, the SO_4^{2-} concentration measured between 2.5–3.0 mmol/L. The concentrations of Fe and Mn were also very high (Wan et al. 1997a). Presently, the case is still serious.

Sulfate-reducing bacteria (SRB) mediate the reduction of heavy metals and metalloids directly and indirectly (White et al. 1997; Hao 2000), and contribute to the biodegradation of organic pollutants (Meckenstock et al. 2000; Chang et al. 2002). SRBs are noticed in the migration of the metals and bioremediation especially in the polluted environment by the acid mine drainage and play an important role in anaerobic bioremediation in contaminated water, soil and subsurface (Franzmann et al. 2002; Kleikemper et al. 2002; Janssen and Timminghoff 2004). There are two fundamental reasons. First, they are capable of abating sulfate to sulfide. These sulfides react additionally with certain metals dissolved in the contaminated waters, such as copper, iron and zinc, to form insoluble precipitates. Second, the carbon metabolism of the bacteria can reduce the acidity of a contaminated system (Garcia et al. 2001). In turn, SRB is affected by environmental conditions and the local composition of the overall microbial community. Hence, when the migration of the metals and bioremediation was researched, there was a need to analyze the vertical and temporal changes of SRB.

In this context, the objective of this study consisted of the vertical and temporal distribution of the SRB groups