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THE MICROBIAL ARSENIC CYCLE IN GROUNDWATER OF LOMBARDIA (ITALY)

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Abstract

Arsenic in contaminated groundwater occurs largely as arsenite [As(III)], while As(V) is more prevalent in surface water. As the presence of arsenic species in drinking water, even in low concentrations, is a threat to human health, the World Health Organization recommends 10μgL^{-1} as the maximum arsenic concentration in drinking water. Groundwater of several Italian regions, has been found to contain As concentrations higher than 10μg L^{-1}, due to the complexity of geological history and to substratum rock types of the regions. Within a project, financed by Fondazione Cariplo (Italy), aimed to study the indigenous microbial communities of As-rich groundwater from Lombardia, we isolated bacteria involved in biogenic As cycle, i.e., in the reduction of As(V) and in the oxidation of As(III). Microbial species with arsenic biotransforming capability had so far not been studied in groundwater in Italy. The objectives of this study were to study the diversity and distribution of culturable As(V)-reducing and As(III)–oxidizing bacteria in groundwater with different As-contaminated levels. Bacteria transforming As were isolated from all groundwater samples collected from 7 sites around Cremona (Lombardia, Italy). While bacteria able to reduce As(V) were isolated from each site, bacteria involved in the oxidation of reduced As species were not always retrieved. In one site, the concomitant presence of an arsenate reducer and arsenite oxidizer was detected, indicating the occurrence of a full As cycle. For the first time, we provide evidence for the presence of an arsenite oxidase gene in an *Aliihoeflea aestuarii* strain and for its As(III)-oxidizing capability. The bacterial oxidation of As(III) to As(V) is being a promising technology for effective removal of As from groundwater as As(V) is more adsorptive to sorbents than As(III). Physico-chemical techniques that are usually used to remove arsenic from contaminated water have however some limitations, such as the use of chemicals with environmental impact, the production of large amount of sludge, the need of secondary treatment, high costs and in some cases a low efficiency.