Development and interpretation of activity test for microbial transformation of inorganic arsenic

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Arsenic is one of the more widespread toxic trace elements, whose presence in environment is linked either to geological background or human activities. The fate of arsenic in environmental compartments is closely linked to the microbial transformations of the inorganic species AsIII and AsV. In order to monitor the evolution of microbial As-related global activities, a simple batch test has been designed and applied. The principle of the test is based on the monitoring of oxidation of 1 mM AsIII in a basal medium inoculated with environmental samples. Results are interpreted considering of oxidation rate or rate constant, and lapse time. Several phenomena are likely to influence the global oxidation rate, such as the relative activity of diverse oxidizing microbes and the competition between oxidizing and reducing processes, in relation to organic matter bioavailability. AsIII oxidizing activities of microorganisms in eight surface soils from polluted sites were quantified with and without addition of organic substrates to the basal medium. Results suggested that AsIII oxidation rate constant was limited by the low concentration of organic substrate, this limitation being removed by supplying 0.08 g/L of organic carbon. Higher organic carbon input negatively affected AsIII oxidation rate constant. Then, the AsIII oxidizing test was applied to a soil highly polluted by the destruction of chemical weapons, simultaneously with the enumeration of AsIII-oxidizing microbes using the Most Probable Number method. Results suggested that the concentration of AsIII-oxidizing microbes was correlated with the lapse time and not with the oxidation rate. Experiments performed with a pure AsIII oxidizing bacterium confirmed a correlation between the lapse time and initial concentration of active cells, AsIII oxidation being detected when the bacterial concentration was close to 10^7 cells ml^{-1}. In these conditions, the oxidation rate was independent from bacterial concentration. In a next step, the influence of microbial AsV reduction parameters will be considered.