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Natural and induced reduction of hexavalent chromium in soil

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Even though naturally elevated levels of chromium can be found naturally in some soils, distressing amounts of the hexavalent form (CrVI) are largely restricted to sites contaminated by anthropogenic activities. In fact, the widespread use of chromium in various industries and the frequently associated inadequate disposal of its by-products and wastes have created serious environmental pollution problems in many parts of the world.
CrVI is toxic to plants, animals and humans and exhibits also mutagenic effects. However, being a strong oxidant, CrVI can be readily reduced to the much less harmful trivalent form (CrIII) when suitable electron donors are present in the environment. CrIII is relatively insoluble, less available for biological uptake, and thus definitely less toxic for web-biota.
Various electron donors in soil can be involved in CrVI reduction in soil. The efficiency of CrVI reducing abiotic agents such as ferrous iron and sulphur compounds is well documented. Furthermore, CrVI reduction is also known to be significantly enhanced by a wide variety of cell-produced monosaccharides, including glucose.
In this study we evaluated the dynamics of hexavalent chromium (CrVI) reduction in contaminated soil amended or not with iron sulphate or/and glucose and assessed the effects of CrVI on native or glucose-induced soil microbial biomass size and activity. CrVI negatively affected both soil microbial activity and the size of the microbial biomass. During the incubation period, the concentration of CrVI in soil decreased over time whether iron sulphate or/and glucose was added or not, but with different reduction rates. Soil therefore displayed a natural attenuation capacity towards chromate reduction. Addition of iron sulphate or/and glucose, however, increased the reduction rate by both abiotic and biotic mechanisms. Our data suggest that glucose is likely to have exerted an indirect role in the increased rate of CrVI reduction by promoting growth of indigenous microbial biomass, while iron sulphate exerted a direct abiotic role.