Enhanced abiotic removal of methyl parathion mediated by HA in aqueous hydrogen sulfide

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Although the abiotic degradation of methyl parathion by the reduced sulfur species (e.g., HS^- and S_n^{2-}) had been tested extensively, comparatively little is known on its reduction in aqueous hydrogen sulfide containing sediment humic acid (HA) under anoxic conditions. In this work, the enhanced abiotic removal of methyl parathion mediated by sediment HA in aqueous hydrogen sulfide was investigated. It was found that the removal efficiency of methyl parathion was remarkably dependence on the HA loading where the reaction followed by pseudo-first-order model well. The results of anthraquinone-mediated transformation experiments confirmed that substantial quinone moities as electron transfer mediators in sediment HA were involved in the enhanced reduction of methyl parathion in aqueous hydrogen sulfide. Elemental sulfur (S^0) produced by the redox reaction between the sulfide and HA could further improve the degradation rate of methyl parahtion. The calculated contribution of nitro-group reduction to the overall degradation of methyl parathion varied from 76% to 88% for the sediment humic acids at pH 7.2. Based on the transformation products identified by gas chromatography-mass spectrometer and liquid chromatography high resolution mass spectrometer, both the nitro group reduction and hydrolysis (S_N@C) processes were proposed to be two predominant reaction mechanisms for the HA-mediated reduction of methyl parathion in aqueous hydrogen sulfide. In conclusion, our findings provide novel insights into the critical role of sediment HA on the abiotically reduction of methyl parathion under anoxic environments.