
Chao Qin,¹ Edward Hunt,¹ and Katerina Dontsova,¹,²* Susan Taylor³

¹ Biosphere 2, University of Arizona, Oracle, AZ, United States
² Department of Soil, Water and Environmental Science, University of Arizona, Tucson, AZ, United States
³ U.S. Army Engineer Research and Development Center, Hanover, NH, United States

New insensitive munition compounds have been developed to replace traditional high explosives to prevent unintended detonations during transport, manufacture and handle. 2,4-dinitroanisole (DNAN) and NTO (3-nitro-1,2,4-triazol-5-one) are two main important ingredients in insensitive munitions (IMs). While some work has been conducted on DNAN and NTO adsorption over whole soils, the individual role of high reactive soil components (including organic matter, iron oxides and phyllosilicate clays) in soils and how they interact with insensitive munition compounds are still unknown. The main objective of this study was to investigate the influence of organic matter, phyllosilicate clays, and iron oxides on DNAN and NTO adsorption to water-dispersible clay (WDC). Clay fraction (<2 µm) was extracted from 3 different soils by repeated suspension and sedimentation, which was further fractionated into different fractions with/without organic matter, oxalate extractable iron, and dithionite-citrate extractable iron removal. Batch adsorption studies were conducted to determine adsorption isotherms for whole soils, untreated, and treated WDC. After adsorption equilibrium, the remaining DNAN and NTO concentrations in supernatant were quantified with high performance liquid chromatography (HPLC). The adsorption coefficients for different fractioned clay components were calculated and evaluated. Results showed that Catlin soil with high organic matter has largest DNAN adsorption, while sassafras soil with lowest clay content and CEC has lowest DNAN adsorption. NTO adsorption onto soils was much lower and differences between soils were not as pronounced. Moreover, removal of amorphous Fe oxides coating from clay surface could destabilize clays aggregates and platelets, free up more reacting sites, and therefore greatly improved DNAN adsorption. Also, IMX-101 adsorption on clay indicated potential of groundwater contamination from NQ and NTO. Our study enables better understanding of how the reactive soil components
contribute to the IMs adsorptions on soils and thus, shed new light on the transport behavior/mechanism of IMs in soil environment.