

Energetic compounds (RDX and 2,4-DNT) are most vulnerable to movement through discontinuous permafrost soils during initial freeze-thaw events

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Polar regions are geopolitically valuable and ecologically sensitive. The Arctic is warming faster than any other region on Earth, resulting in changing seasonality and precipitation patterns that are leading to alterations in above ground vegetation, permafrost stability, and summer sea ice extent. Collectively, these poorly defined ecosystem changes play critical roles in affecting the transport and eventual fate of persistent military relevant contaminants through unique arctic and subarctic terrestrial environments. Yet it is not known how changes in the arctic temperature regime will impact the fate and transport of military relevant chemicals, including energetic compounds, in discontinuous permafrost soils. Here we show that energetic compounds are most vulnerable to movement through discontinuous permafrost soils during initial freeze-thaw events. This study systematically parameterizes the partitioning coefficients (K_d) of the energetic compounds 2,4-DNT and RDX in subarctic discontinuous permafrost soils from interior Alaska. We found that the K_d of both compounds decreased as the soils underwent laboratory-controlled freeze-thaw cycles. We also compared sorption of 2,4-DNT and RDX on discontinuous permafrost soils at two distinct temperatures and found that warmer temperatures lead to decreased sorption for 2,4-DNT and increased sorption for RDX. These results demonstrate the dynamic nature of chemical behavior in discontinuous permafrost soils. These results can inform management decisions related to military relevant contaminants in Arctic terrestrial environments as new climate patterns occur.