Changing how we view chlorine in soil

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Researchers at Linköping University have studied how combinations of different environmental factors affect the chlorination of organic matter in soils. The results show that the supply of fresh organic compounds, which promote the growth of the microorganisms, increases chlorination. The discovery could mean that chlorine in ecosystems has a different significance than previously believed.

Chlorine is one of the most common elements on earth, and scientists long believed that sodium chloride (common salt) was the most common form. Previous studies at Linköping University have shown that organic chlorine forms dominate in soil, and that an extensive chlorination of organic matter occurs there. But it has not been known what affects these processes. Now the researchers have come one step closer to understanding why so much organic chlorine is bound in the soil.

"There are previous studies into what affects the formation of organic chlorine in the ground, but these investigated one environmental factor at a time. What's unique about this study is that we have studied several factors simultaneously. This has revealed new patterns", says David Bastviken, professor at Linköping University.

The environmental factors that were studied in combination in the new study are soil moisture, nitrate, chloride and carbon. By way of two large experiments with forest soil from the Swedish regions of Kolmården and Linköping, the researchers were able to measure how the various environmental factors affect chlorination. The addition of easily degradable organic carbon forms (such as glucose) was found to increase

chlorination significantly. The results have been published in the scientific journal *Environmental Science & Technology*.

Chlorination - more than persistent compounds

The main players in the chlorination process are the microorganisms that have the ability to chlorinate the soil. Previously, researchers believed that microorganisms, in particular fungi, chlorinate organic material in order to break it down into smaller 'edible' pieces. The study from Linköping University shows that this is probably not the case.

When the microorganisms are favoured, which in the experiment was done by giving them access to easily obtainable organic carbon, it turned out that chlorination actually increased dramatically. That is, chlorination increased when the microorganisms had easier access to food. Thus, chlorination can have important ecological functions related to the activity of microorganisms, such as dealing with dangerous oxygen radicals that form during metabolism, or being part of the chemical battle that the microorganisms are engaged in, in the competition for resources in the ground.

Chloride in soil has also been considered a non-reactive element, i.e. one that does not react to other chemical elements and compounds.

"However now we show that chloride is reactive. These are ecological functions that we are beginning to discover, and a revised view of chloride is also interesting from a societal perspective. For instance when developing risk models for radioactive waste that includes radioactive chloride", says Teresia Svensson, senior lecturer at Linköping University.

Malin Montelius, Malin Andersson, Cecilia Lindberg, Henrik Reyier, Karolina Rietz and Åsa Danielsson from Linköping University also took

part in the study.

More information: Teresia Svensson et al, Influence of Multiple Environmental Factors on Organic Matter Chlorination in Podsol Soil, *Environmental Science & Technology* (2017). DOI: 10.1021/acs.est.7b03196

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