# Chemists identify role of soil in pollution control

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Credit: Alfred Palmer/Wikipedia

Scientists have long known that air pollution caused by cars and trucks, solvent use and even plants, is reduced when broken down by naturally occurring compounds that act like detergents of the atmosphere. What has not been well understood until now are the relative contributions of

all the processes producing such compounds.

A new study, led by University of Toronto atmospheric chemist Jennifer Murphy, shows a key component of the process is the soil beneath our feet.

"Pollutants in the atmosphere are broken down by hydroxyl radicals that are produced when nitrous acid breaks down in sunlight," said Murphy. "What scientists have been working to solve for over 15 years is where nitrous acid comes from during the daytime."

Murphy and her team investigated chemical interactions that take place when different components of the atmosphere reach the ground. "We found that soil can take up nitrous acid at night when these components react with carbonate minerals often found in soil. Examples of everyday carbonates are lime and sodium bicarbonate, commonly known as baking soda," said Murphy.

"The following day, nitrous acid is displaced from the soil and released into the atmosphere by the strong acids nitric acid and hydrochloric acid ," said Trevor VandenBoer, lead author of the study published today in *Nature Geoscience* and former PhD student in Murphy's research group, now a Banting postdoctoral fellow at Memorial University. "Those strong acids are the product of combustion processes that occur in virtually all environments, so this cycle occurs daily."

Nitrous acid breaks down extremely quickly in sunlight to form hydroxyl radicals. So, something must be producing nitrous acid just as quickly, or at least in sufficient amounts, during the daytime in order to reach measurable concentrations.

To find the answer, the researchers designed a combination of experiments to measure nitrous acid reacting with atmospheric particles

they suspected were coming from soils. They followed up on promising field observations with laboratory tests and discovered that nitrous acid can be taken up by soils and subsequently released the next day through reaction with the stronger acids.

The team found nitrite - the salt form of nitrous acid - in particles containing large amounts of calcium and sodium. This suggested that reactions with mineral dust or soil produces nitrite salts, which react with the stronger acids produced by combustions processes, releasing nitrous acid.

"We have demonstrated a process through which a significant amount of nitrous acid can be produced and observed in the daytime," said Murphy.

"This process can account for the majority of daytime nitrous acid produced from noon through sunset," said VandenBoer. "Other mechanisms proposed previously have not been shown to be equally important both in the lab and in the field."

"This discovery allows us to better understand the sources of hydroxyl radical," said Murphy. "Knowing where nitrous acid comes from during the daytime helps to understand the factors controlling air pollution."

**More information:** The research is described in a study titled "Nocturnal loss and daytime source of nitrous acid through reactive uptake and displacement" published in *Nature Geoscience*.

Provided by University of Toronto