Geologists mapped how metal pollutants have traveled across the city

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Pittsburgh's steel industry may be largely in the past, but its legacy lives on in city soils. New research led by Pitt geologists shows how historical coking and smelting dropped toxic metals in Pittsburgh's soil, particularly in the eastern half of the city.

"I don't think people need to be scared, but I think they need to be

aware," said Alexandra Maxim (A&S '19G), now a Ph.D. student at Georgia Tech, who led the research as a Pitt master's student. "Make sure you test your soil and be thoughtful about your gardening and your children playing in certain areas."

While the most severe levels of soil lead come from concentrated sources, those aren't the only factors that can make dirt harmful to garden or play in, especially in a city with industrial history like Pittsburgh.

"The gut reaction when you're thinking about urban metals is to think it's all gasoline lead or paint lead, and as long as you take care of those, you're in good shape," said coauthor Daniel Bain, an associate professor in the Kenneth P. Dietrich School of Arts and Sciences. "But we don't really have a good idea of other less common or more diffuse sources of lead."

Understanding those other sources requires looking beyond houses and roads to areas with relatively undisturbed soil—and only recently have the tools for testing soil samples become common enough for researchers to branch out from the most concentrated and worrisome sources of pollution, Bain added.

With samples from 56 parks, cemeteries and other sites around the city collected by Carnegie Mellon University students and Jonathan Burgess from the Allegheny County Conservation District, the team was able to pinpoint some of those polluting factors. They recently published their results in the journal *Environmental Research Communications*.

Concentrations of soil metals were generally higher in the east end of the city, likely a result of wind patterns, and the city's geography also plays a role, the team found. Levels were higher in the two large, flat valleys that crisscross Pittsburgh: the historical paths of the Allegheny and

Monongahela rivers.

These valleys still influence local weather patterns, serving as the site of temperature inversions that trap pollution close to the ground. Along with worsening air pollution, the team theorizes, inversions may have given heavy metals from historical industrial sites a chance to settle from the air into the soil.

"All the industrial activity was along the rivers, and if you think about the smoke and wind patterns, it makes sense that they would settle in these valleys," said Maxim.

To pin the pollution to likely sources, the team measured the ratios of different pollutants, comparing them to the outputs of different industrial processes. For Maxim, that meant not just learning statistics and mapping techniques but sorting and cross-referencing historical sources to locate past coking plants and smelters. She also had to determine what metals they released into the air.

Even with that painstaking work, there was a limit to what the team could piece together. "We really had to dig, and I feel like I just scratched the surface of these records," Maxim said. "It was a really fascinating experience—I felt like I knew Pittsburgh in a very intimate way as a result of this study."

The team searched for several pollutants, including arsenic, cadmium, zinc and copper. While lead tends to dominate conversations about soil metals, others often fly under the radar—like cadmium, which can replace the calcium in bones and increase the chances of a fracture.

"Cadmium is in coal, and it boils at about the same temperature that we would coke coal, something we have a long history of in Pittsburgh," Bain explained. "So this is probably something we should probably be

more concerned about."

The concentrations the team discovered aren't immediately alarming, Bain said—most fall well below the action levels that regulatory agencies use to determine whether a problem needs to be addressed. But those who garden or have young children may still want to get their soil checked. He pointed to resources offered by the Allegheny County Conservation District for those interested in learning about their soil.

Maxim offered another suggestion. She now lives in Atlanta and found her own backyard had high lead levels, a concern for her due to her 13-month-old child. She pointed to the hope offered by the burgeoning field of "phytoremediation": using plants to lock up harmful pollutants.

"If you have high vegetation that kind of keeps the soil in place without letting it move, that helps," she said. "Other vegetation like sunflowers can uptake metals. There are things we can do with our environment other than just lawns. We have avenues for keeping ourselves safe."

And the team is doing further testing on the precise forms the pollutants in Pittsburgh take—whether they're harmful to humans as is or locked in chemical compounds that keep them from making their way into the bodies of living creatures. While there's more to learn, Bain said, it still doesn't hurt to be safe.

"I don't think we need to dig up the entire city and replace it with fresh soil," said Bain. "But this sort of drives home the point that people should take advantage of the public health measures that are available."

More information: Urban soils in a historically industrial city: patterns of trace metals in Pittsburgh, Pennsylvania, *Environmental Research Communications* (2022). DOI: 10.26022/IEDA/112208

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