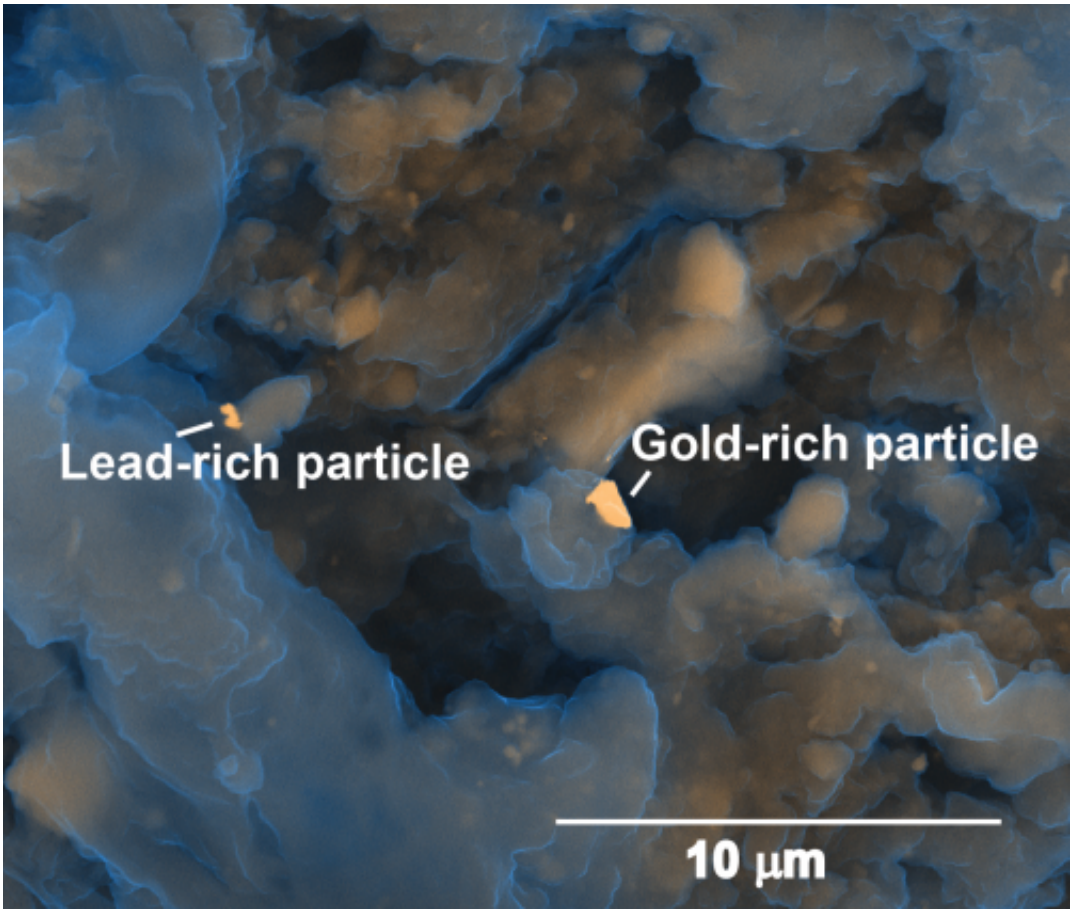
Sewage could be a source of valuable metals and critical elements

March 23 2015



Microscopic gold-rich and lead-rich particles in a municipal biosolids sample. Credit: Heather Lowers, USGS Denver Microbeam Laboratory

Poop could be a goldmine—literally. Surprisingly, treated solid waste contains gold, silver and other metals, as well as rare elements such as

palladium and vanadium that are used in electronics and alloys. Now researchers are looking at identifying the metals that are getting flushed and how they can be recovered. This could decrease the need for mining and reduce the unwanted release of metals into the environment.

A talk about their recent work will be one of nearly 11,000 presentations here at the 249th National Meeting & Exposition of the American Chemical Society (ACS).

"If you can get rid of some of the nuisance metals that currently limit how much of these biosolids we can use on fields and forests, and at the same time recover valuable metals and other elements, that's a win-win," says Kathleen Smith, Ph.D.

"There are metals everywhere," Smith says, noting they are "in your hair care products, detergents, even nanoparticles that are put in socks to prevent bad odors." Whatever their origin, the wastes containing these metals all end up being funneled through wastewater treatment plants, where she says many metals end up in the leftover solid waste.

At treatment plants, wastewater goes through a series of physical, biological and chemical processes. The end products are treated water and biosolids. Smith, who is at the U.S. Geological Survey (USGS), says more than 7 million tons of biosolids come out of U.S. wastewater facilities each year. About half of that is used as fertilizer on fields and in forests, while the other half is incinerated or sent to landfills.

Smith and her team are on a mission to find out exactly what is in our waste. "We have a two-pronged approach," she says. "In one part of the study, we are looking at removing some regulated metals from the biosolids that limit their use for land application.

"In the other part of the project, we're interested in collecting valuable

metals that could be sold, including some of the more technologically important metals, such as vanadium and copper that are in cell phones, computers and alloys," Smith said. To do this, they are taking a page from the industrial mining operations' method book and are experimenting with some of the same chemicals, called leachates, which this industry uses to pull metals out of rock. While some of these leachates have a bad reputation for damaging ecosystems when they leak or spill into the environment, Smith says that in a controlled setting, they could safely be used to recover metals in treated solid waste.

So far, her group has collected samples from small towns in the Rocky Mountains, rural communities and big cities. For a more comprehensive picture, they plan to combine their information with many years' worth of existing data collected by the Environmental Protection Agency and other groups at the USGS.

In the treated waste, Smith's group has already started to discover metals like platinum, silver and gold. She states that they have observed microscopic-sized metal particles in biosolids using a scanning electron microscope. "The gold we found was at the level of a minimal mineral deposit," she says, meaning that if that amount were in rock, it might be commercially viable to mine it. Smith adds that "the economic and technical feasibility of metal recovery from biosolids needs to be evaluated on a case-by-case basis."

In a recent *Environmental Science & Technology* paper (2015, DOI: 10.1021/es505329q), another research group also studying this issue calculated that the waste from 1 million Americans could contain as much as $13 million worth of metals. That's money that could help fuel local economies.

More information: Metal occurrence in and potential recovery from municipal biosolids, 249th National Meeting & Exposition of the

American Chemical Society (ACS).

Abstract

Recovery and reuse of potentially valuable metals and newly emerging technologically important (critical) elements from waste streams can decrease U.S. reliance on primary resources and lessen unwanted dispersion of metals in the environment, while reducing disposal costs and regulatory liabilities for generators. Municipal biosolids, which are nutrient-rich organic materials produced from the treatment of domestic sewage in a facility, can contain significant concentrations of metals and may provide an opportunity for metal recovery from a waste stream. In excess of 7 million dry tons of biosolids are generated in the U.S. each year by approximately 16,500 municipal wastewater treatment facilities. The U.S. EPA analyzed 28 metals for their 2009 Targeted National Sewage Sludge Survey (TNSSS; samples randomly selected from 3,337 facilities that treat more than 1 million gallons per day), including these potentially valuable and critical elements (mg/kg): (1) Ag (range 2-856; mean 30), (2) Cu (range 115-2,580; mean 563), and (3) V (range 2-617; mean 36). An eight-year study by the USGS involved monthly sampling and analysis of biosolids from a municipal wastewater treatment plant. Some potentially valuable and critical element data (ppm) from that study include: (1) Ag (range 12-61; mean 28), (2) Cu (range 474-845; mean 638), (3) V (range 11-128; mean 49), and (4) Au for a limited number of samples (range 0.1-0.6). Leaching studies with extractants used by the mining industry will help demonstrate the recovery potential of metals from biosolids. An added benefit is that some metals, such as Pb, represent "nuisance" metals that are regulated for use of biosolids as soil amendments. Removal and recovery of these metals from the biosolids prior to land application could extend the application period for the applied fields. However, the economic and technical feasibility of metal recovery needs to be evaluated on a case-by-case basis.