

SCIENCE SEP 26 2013, 3:30 PM ET

The surprising source of most mercury pollution: Gold mining

by DOUGLAS MAIN



These gold nuggets were found in southern Oregon, but many illegal "artisanal" miners operate in developing countries like Peru, where there is little or no regulation. Those are a major contributor to mercury pollution.

If, as Robert Frost wrote, "nothing gold can stay," then mercury sticks around forever.

Mercury has an uncanny ability to bind to precious metals, and for millennia, people have used it to mine gold and silver. Small-scale, or "artisanal," mining — which makes use of mercury in this way — has recently become the leading source of mercury pollution, several recent studies show.

Mining releases mercury into the air when it is burned off to isolate gold from a chunk of rock or slurry; it also seeps into the soil and rivers from water used in the process and runoff from rainwater, contaminated by materials left behind from mining operations.

Many of these miners operate illegally in developing countries like Peru, where there is little or no regulation, making the practice difficult to quash, said Dave Krabbenhoft, a researcher at the U.S. Geological Survey in Middleton, Wis.

The heavy metal also sticks around for centuries, and is re-emitted from the soil and the water into the atmosphere, and vice versa. As a volatile element, mercury can evaporate at relatively low temperatures, and can then be deposited out of the atmosphere through chemical reactions back to the soil or bodies of water. In fact, most mercury that arrives in the ocean — after falling out of the air or being washed there by rivers — is "legacy" mercury that was already present in the environment, much of it spewed from smokestacks or leached from gold mines hundreds of years ago, Krabbenhoft told LiveScience.

Scientists pay special attention to oceanic mercury because this is where the element is converted into methylmercury, the toxic, carbon-containing form that accumulates in fish; eating seafood is the primary way humans are exposed to the heavy metal, he said. Most methylmercury is produced by microbes in dark conditions, according to a study published earlier this year in the journal *Nature Geoscience*.

There is some promising news, however: Delegates from countries around the world will meet in Minamata, Japan, in early October to formalize an agreement to reduce mercury pollution in a number of ways. However, that news is tempered by a review published Thursday in the journal *Science* that suggests mercury levels in the environment will likely continue to rise for decades, said Krabbenhoft, a co-author of the study.

Reducing mercury

Goals of the meeting include closing all mercury mines in signatory countries within 15 years of the convention taking effect. Many consumer products containing mercury are also expected to be phased out, and mercury-containing dental amalgams will be "phased down," according to a *Science* article accompanying the review. Many of the countries where artisanal mining is a problem — especially those in South America, Southeast Asia and Africa — will also pursue efforts to try to fight this problem, *Science* reported.

The convention will be held in Minamata, in part, because the city is home to the first and most notorious case of mercury poisoning: 65 years ago, a chemical plant released large quantities of methylmercury in its waste into the ocean, where it accumulated in fish and poisoned thousands. Many died, and many more suffered brain damage, mental retardation, birth defects and other health problems, said Dr. Philippe Grandjean, an epidemiologist at Harvard University who has conducted field work at Minamata and has been involved in drafting the convention's rules. But the source of the so-called "Minamata disease" took years

to definitively link to mercury, due, in part, to resistance from the chemical company that released the mercury, and it took even longer to spur international action, Grandjean said. [World's 10 Most Polluted Places]

But Grandjean and others think that the convention — the language of which has already been crafted and written — doesn't go far enough. Many of the agreements are voluntary and qualified with the phrase, "where feasible," the Science article noted.

Grandjean said one of the primary problems is that the convention doesn't do enough to reduce mercury exposures in the short term. In fact, due to the long-lasting nature of the pollutant, "mercury in the environment is going to increase, probably for decades," as the mercury that is already there hangs around, and new mercury — even if in smaller quantities than before — finds its way into the environment, Grandjean told LiveScience.

Worse in the near term

One step people can take to reduce their exposure to mercury, Grandjean said, is to eat fish that accumulate less mercury, such as small and short-lived fish like sardines; methylmercury gradually travels up the food chain and is most prevalent in large, old carnivorous fish, he added. [Is Sushi Safe to Eat?]

"We have already put so much mercury into the ecosystems that it's going to take decades before we can benefit from the U.N. treaty," Grandjean said. "In the meantime, we have to select our seafood prudently."

Grandjean hopes that efforts to reduce small-scale mining will pan out. But the construction of new coal plants, particularly in China, isn't encouraging, since fossil fuels are the second-largest source of mercury pollution, said Krabbenhoft. Climate change may also worsen mercury pollution, as a warmer world is expected to bring more intense floods and wildfires, both of which release mercury bound up in soil and vegetation, he said.

The convention is a good first step, but the persistent nature of mercury means that the situation will get worse before it improves, Grandjean said, though he still has hope that mercury pollution can be curbed.

"Just because we didn't get an optimal treaty doesn't mean we lost," Grandjean said. "We should still regard it as a victory, but there's a lot more work to be done."

Email Douglas Main or follow him on Twitter or Google+. Follow us @livescience, Facebook or Google+. Article originally on LiveScience.

- World's 10 Most Polluted Places
 - Humans Hit the Oceans Hard
 - Earth in the Balance: 7 Crucial Tipping Points
-