**The World Needs Copper. Does It Need This Controversial Mine?**

**The fight over the proposed Pebble mine in southern Alaska is a harbinger: Global copper demand is expected to grow dramatically.**

Sockeye salmon return from the ocean to their natal stream near Iliamna Lake, downstream from the proposed Pebble mine site.

PHOTOGRAPH BY MICHAEL MELFORD, NATIONAL GEOGRAPHIC CREATIVE

By **Julia Rosen**

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On a Thursday in October, dozens of Alaskans piled into a cavernous airplane hangar in the remote village of Iliamna to discuss — yet again — the fate of the proposed [Pebble Mine](https://news.nationalgeographic.com/news/2012/11/121116-bristol-bay-alaska-salmon-gold-pebble-mine-science-nation/). Seventeen miles to the northwest, underneath snaking rivers and spongy bogs, lies one of the largest undeveloped deposits of copper and gold in North America. Mining companies have been exploring it for decades. But many fear that an open pit mine here, at the headwaters of two of the last great salmon rivers on Earth, will harm fish — and the people who depend on them.

In 2014, the Environmental Protection Agency moved to [impose restrictions](https://www.epa.gov/bristolbay/2014-proposed-determination-pursuant-section-404c-clean-water-act-pebble-deposit-area) that would have blocked plans for a large mine, citing the impacts on fish-bearing streams, lakes, ponds, and wetlands. But the mine’s backers sued, putting the restrictions on hold. Now, Northern Dynasty Minerals, the Canadian company that owns Pebble Partnerships, may get another shot under the Trump administration. Following [a meeting](https://www.washingtonpost.com/apps/g/page/politics/epa-administrator-scott-pruitts-schedule-from-april-3-2017-to-sept-8-2017/2241/?tid=a_inl) between Pebble executives and EPA administrator Scott Pruitt in May, the agency settled the lawsuit and announced plans to [abandon the Obama-era restrictions](https://www.epa.gov/bristolbay/2017-proposal-withdraw-proposed-clean-water-act-restrictions-mining-pebble-deposit).



**Alaskan natural resources at risk**

**39.8**

**million**

Number of fish harvested in 2017 season

**$480**

**million**

Estimated annual economic activity generated by

the watershed’s ecological resources

**14,000**

Number of full- and part-time jobs provided by the

watershed’s ecological resources

**25**

Number of recognized tribal governments

in the Bristol Bay region

SOURCES: ALASKA DEPARTMENT OF FISH AND GAME;

U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA officials were in Iliamna to hear what the public thought of the reversal. According to [local news reports](https://www.alaskapublic.org/2017/10/13/in-iliamna-epa-hears-mixed-reactions-to-its-new-course-on-pebble-mine/), a few attendees spoke up in favor of the mine, but many residents of the region — including more than 80 percent of its Native Alaskan population — are strongly against it. “It’s not acceptable in any form,” says Alannah Hurley, executive director of the United Tribes of Bristol Bay. Native Alaskans depend on salmon and other wild foods for both physical and spiritual sustenance, she says. “If the environment is harmed, therefore our people are harmed.”

Many commercial fishers in Bristol Bay, which boasts the largest sockeye salmon fishery in the world, also oppose the mine, along with environmental groups and even some of Alaska’s normally [pro-resource political figures](http://thehill.com/blogs/congress-blog/energy-environment/212674-no-to-pebble-mine). “Their problem is one of location, and that’s never going to change,” says Taryn Kiekow Heimer, a senior policy analyst at the Natural Resources Defense Council. “They are just sitting at the headwaters of this incredibly productive ecosystem.”

Yet an uncomfortable truth underpins this debate: America — and the world — has a voracious appetite for minerals, including copper and gold. And that appetite is projected to grow. A [recent study](http://www.sciencedirect.com/science/article/pii/S0959378016300802) found that global copper demand could increase by as much as 350 percent by 2050, exhausting current reserves sometime between 2035 and 2045.

Keeping pace will almost certainly require opening new mines, says Thomas Graedel, a retired industrial ecologist at Yale University and an author of the study. He understands why many people take a skeptical view of mining; the industry has a long history of abusing workers and the environment. But he doesn’t see an alternative. “We can’t imagine a world that we would like that

The question, then, isn’t whether to mine. It’s where to mine — and how to do it better.

**WHY WE DIG**

Economic geologists are fond of pointing out that if you can’t grow it, you have to mine it. And indeed, mined products are everywhere in modern life — in tin cans, smart phones, and even toothpaste (which contains crushed up minerals like calcite and mica). The [USGS estimates](https://minerals.usgs.gov/granted.html) that, in a lifetime, the average American will use more than 5,600 pounds of aluminum, almost 20,000 pounds of phosphate rock (mostly as crop fertilizer) and nearly 30,000 pounds of iron ore, to say nothing of all the plastics made from oil that had to be extracted from the ground.

The metals in question at Pebble include gold and molybdenum, but the biggest product would be copper. Today, humans consume more than 20 million metric tons of copper per year, making it one of the most widely used metals. Most copper goes into wiring, plumbing, and infrastructure, including bridges, water treatment plants, and the electrical grid. Copper is also used in building construction, appliances, and electronic equipment, among other applications.

Unless scientists come up with a suitable replacement, demand for copper will grow as the world’s population increases and more people attain higher standards of living, Graedel says. “There is very good evidence that affluent people go out and buy stuff, and that stuff takes resources,” he says. The more equitably the word develops, the more copper we will need, his study found.

Green technologies, from solar panels to wind turbines, also require a lot of copper. Every electric car contains more than 150 pounds of it. As a result, a recent [World Bank report](http://www.worldbank.org/en/news/press-release/2017/07/18/clean-energy-transition-will-increase-demand-for-minerals-says-new-world-bank-report) concluded that limiting climate change to 2

Recycling could help meet some of this increased demand, but the potential is limited, Graedel says. The problem is that copper often goes into products that last a long time. When they do reach the end of their useful lives, about half of that copper is already reclaimed, but that satisfies less than a fifth of current demand. “Even if we are 100 percent efficient on what comes out of use,” Graedel says, “we will never have enough solely from that source to meet demand.”

**THE DIRTY PART**

Unfortunately, the troubling environmental legacy of metal mines is also long-lasting. Sediments in Lake Superior hint at pollution from 6,000-year-old Native American [copper mines](http://journals.sagepub.com/doi/abs/10.1177/0959683614557574) on Isle Royale. In the Sierra Nevada, some fish still contain unsafe levels of the mercury used to extract gold during the California Gold Rush. And across the American West, abandoned mines [continue to leach acid and heavy metals](https://news.nationalgeographic.com/2015/08/150814-hardrock-mines-toxic-waste-pollution-colorado-mine-environment-gold-king-spill/) from waste rock and tailings — the crushed material left over after the metals have been extracted from ore.

Mining has gotten cleaner in recent decades, says Robert Seal, a geologist with the US Geological Survey. Companies have come up with new ways to process ore and extract metals. They sometimes neutralize rock waste containing sulfide minerals, which are usually the culprit behind acid mine drainage, and they regularly treat wastewater before it flows into the environment. “There have been improvements all across the board,” Seal says. But there’s still a lot of room for improvement.

Storing tailings as a wet slurry in contained ponds, as Pebble has proposed to do, helps reduce acid drainage. But it’s also the most common source of modern mining accidents. In August 2014, in the mountains of British Columbia, [a dam burst at the Mount Polley mine](http://www.cbc.ca/news/canada/british-columbia/mount-polley-mine-tailings-pond-breach-called-environmental-disaster-1.2727171), releasing muddy water contaminated with mine waste into rivers and lakes inhabited by Chinook salmon and rainbow trout. And in 2015, a [dam failure](https://www.theguardian.com/sustainable-business/2015/nov/25/brazils-mining-tragedy-dam-preventable-disaster-samarco-vale-bhp-billiton)at an iron ore mine in Brazil flooded entire villages and killed at least 11 people.

**VIEW IMAGES**

Nushagak Bay, downstream from the proposed mine at the mouth of the Nushagak River, is the site of a rich salmon fishery.

PHOTOGRAPH BY MICHAEL MELFORD, NATIONAL GEOGRAPHIC CREATIVE

The root cause of such disasters is often more political than technical, says Erica Schoenberger, a geographer at Johns Hopkins University. [In a 2016 study](http://www.sciencedirect.com/science/article/pii/S0301420716300782), Schoenberger analyzed three different mines — including Mount Polley — to understand why some fail while others succeed. “It seemed to me that what was standing between the engineers and safe mining, if not beautiful mining, was the regulatory structure and the corporate structure,” she says. In other words, engineers know how to manage tailings safely, but their advice often goes unheeded.

Under the right conditions, though, mines can work well. The McLaughlin gold mine in California, which Schoenberger cites as a model, was bound by the state’s stringent laws, but even more by the high stakes of operating near Napa County’s wine country. To reduce the chances of an accident, the Homestake mining company built its tailings dam to standards that far exceeded state regulations. It also converted the mine to a nature reserve after it closed in 2002.

Schoenberger says that engineers now have even better options, albeit more expensive ones, for storing tailings safely, like drying and stacking them into stable, covered piles. A [post-mortem of the Mount Polley accident](https://www.mountpolleyreviewpanel.ca/) concluded that subjecting tailings facility plans to review by outside experts and adopting new storage methods are key to reducing the risk of future failures.

Does that mean that any mine can be safe? Payal Sampat of Earthworks, a nonprofit, says no. Sampat serves on the steering committee of the [Initiative for Responsible Mining Assurance](http://www.responsiblemining.net/). IRMA grew from the belief that mining can be done better, and it’s developing criteria to certify environmentally and socially responsible mines. But, Sampat says, “any conversation about how mining can be done more responsibly would have to start with the premise that there are some places that are too precious to mine.”

She thinks Pebble is one of them.

**BETTER THAN SOCKEYE?**

Pebble does have its supporters, including Graedel. The US is currently a net importer of the minerals that would be mined at Pebble, he says. If we choose not to develop it, he says, “then I think that means we are saying that we would like those sorts of mines to be developed somewhere else, probably where the controls would be less stringent than they would be if a mine were developed in the US.” Graedel would like to see the mine opened, but with the strongest possible protections in place.

Seal is less certain. Mines are unique, he says, because “you are kind of stuck with building it wherever you find the ore deposit, and they are very rare, globally speaking.” But that often brings mines in conflict with other valuable resources, like world-class fisheries, he says. “The question is, can we have both?” At Pebble, Seal says, the answer requires carefully analyzing the environmental impacts of the mine’s proposal — and potential alternatives — which won’t be possible until Pebble formalizes its plan. “I don’t know what the right answer is at this point,” Seal says.

**VIEW IMAGES**

In 2014 a dam burst at the Mount Polley mine in British Columbia, releasing millions of tons of water contaminated by mine tailings into Polley Lake.

Speaking at a breakfast meeting of the Resource Development Council for Alaska last month, Pebble CEO Tom Collier [announced preliminary plans](https://vimeo.com/236963415)for what he said would be a smaller, safer mine. Collier said that the company had made numerous changes in response to concerns, including abandoning the use of cyanide to recover a portion of the gold and building a sturdier tailings dam.

Collier also announced that the mine would scale back dramatically, targeting just a fraction of the deposit. The new plan calls for a 5.4-square-mile footprint, down from an estimated 13 square miles, and requires just one of three proposed tailings facilities, limiting its impact to a single tributary of one of nine major rivers that drain into Bristol Bay. (The company has decided not to pursue dry stacking, because it would increase the mine’s footprint, according to a spokesperson.)

But the mine’s opponents remain unconvinced. According to the EPA’s [2014 assessment](https://www.epa.gov/bristolbay/bristol-bay-assessment-final-report-2014), which formed the basis for its restrictions, even a small mine would have significant and irreversible impacts on wetlands, rivers, and fish, says Heimer of the NRDC. And she suspects that the new plan is just a foot in the door—a first step toward exploiting the larger potential of the deposit, which Pebble’s backers continue to tout to investors.

Any day now, the EPA will announce whether or not it will lift its restrictions. Pebble will have 30 months to submit an application for a permit and begin seeking regulatory approval—but the fight won’t be over. Alaska voters are [pushing a ballot initiative](https://www.adn.com/alaska-news/environment/2017/10/09/judge-overrules-mallott-sides-with-environmental-group-on-salmon-initative/) that would require the state department of fish and game to grant permits for any project that could affect salmon habitat. And the mine has amassed many high-profile critics over the years. Dozens of jewelers — including Tiffany and Co. — have [signed a pledge](http://www.stoppebblemine.org/bristol-bay-protection-pledge.html) not to buy gold from Pebble.

Front and center are the voices of Native Alaskans, who — like many indigenous people living on resource-rich land — have the most at stake. Hurley says she understands the need to mine. But there has to be a limit to the sacrifice, she says: “If this place is not worth saving, what is?”