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SCIENCE

## Is California on the Verge of a Second Gold Rush?

Gold mines are reopening in places where mining was once thought to be economically unfeasible.

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Rise Gold CEO Benjamin Mossman holds a section of core sample containing chunks of gold. (Elias Funez / The Union / AP)

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On the outskirts of the Northern California town of Grass Valley, a massive concrete silo looms over the weeds and crumbling pavement. Nearby, unseen, a mine shaft drops 3,400 feet into the earth. These are

the remains of Grass Valley's Idaho-Maryland Mine, a relic from the town's gold-mining past. Numerous mines like this one once fueled Grass Valley's economy, and today Gold Rush artifacts are part of the town's character: A stamp mill, once used to break up gold-bearing rock, now guards an intersection on Main Street, and old ore carts and other rusty remnants can be spotted in parking lots and storefronts around town.

Gold still exists in the veins of the abandoned mine, and Rise Gold, the mining corporation that purchased the mine in 2017, has reason to believe that reopening it makes financial sense. When the mine shut down in 1956, it wasn't because the gold was drying up; it was because of economic policy. The 1944 Bretton Woods Agreement had established a new international monetary system to create stability in exchange rates. As part of the effort, the price of gold was fixed at \$35 an ounce. Gold mining became unprofitable in the U.S.

Today, the price of gold is no longer fixed, and prices have risen in response to the economic uncertainty wrought by COVID-19. At the start of the pandemic, the Federal Reserve lowered interest rates in an effort to stimulate the U.S. economy and encourage borrowing money. But those record-low rates decreased the returns on bonds and savings accounts, making gold a relatively more attractive business investment.

Now, with rising inflation, demand for gold remains high, even despite some recent dips. In 2020, roughly 43 percent of gold consumed globally went towards exchange-traded funds and central banks. As prices have risen and mining technology has become more sophisticated, mines are opening and reopening in places where mining was once thought economically unfeasible.

Still, mining isn't as simple as it used to be. The U.S. Geological Survey estimates that, of the world's known gold, roughly 63,000 tons are still in the ground, compared with roughly 206,000 tons that have

already been mined. And the world's unmined gold is generally unmined only because it's deeper underground and thus less accessible. To obtain it, companies have to figure out what to do with huge amounts of mining waste, some of which contains heavy metals and other toxic substances.

Rise Gold has pledged to mitigate the environmental impact of its new mining operation in part by employing a technique called "paste backfilling," which involves injecting a mixture of water, mine waste, and a binder (often cement) into mining tunnels. The practice helps provide structural support and reduce the amount of aboveground mine waste. There is some science to support the benefits of this approach, but it's only a partial solution and there are lingering uncertainties about its long-term impact. Though Rise Gold reports that the project has strong support throughout Nevada County, where Grass Valley is located, some local residents remain skeptical. Among other things, they are concerned that the new mining operation will not be able to adequately contain its waste.

Given these challenges, some economists are asking whether it makes sense to mine gold when the precious mineral is merely destined for a bank vault. "The cost of mining is high," says the financial economist Dirk Baur. Much of the value of gold is tied up in the cost of just digging it out of the ground, he says. "There's some profit for the mining company, but a big, big chunk is just an expense."

Over the past couple of decades, proposals to develop or expand gold-mining facilities have popped up across Europe and North America. In Northern Ireland, Dalradian Gold plans to open a mine in the Sperrin Mountains. In Newfoundland, Marathon Gold is slated to open an open-pit mine that the company says will be the largest gold-mining operation in Atlantic Canada. In the United States, which, as of 2020, had the fourth-largest gold-mine reserves in the world, mining operations have expanded in northwestern Arizona in recent years, and there are

plans to reopen a mine in central Idaho. Many companies seeking to find new riches in old places face community pushback similar to what is happening in Grass Valley.

Gold-mine opponents have good reason to be wary. Mining creates a lot of waste, including the rock that doesn't contain enough gold to extract (called "waste rock") and the slurry left over after gold has been extracted from ore (called "tailings"). Both waste rock and tailings can contain toxic substances that threaten to pollute groundwater and surface waters if not properly mitigated.

Grass Valley has been dealing with the fallout of Gold Rush–era mining for decades. Arsenic, which occurs naturally in the gold deposits of the Sierra Nevada foothills, remains an ongoing problem in the area. Old tailings can still leach heavy metals decades after mining operations have ceased. In Grass Valley, the Central Valley Regional Water Quality Control Board documented high concentrations of arsenic in a pile of tailings nicknamed "the Red Dirt Pile." In 2020, high concentrations of lead, mercury, and arsenic were found in samples taken from a former mine-waste disposal area that now supports approximately four and a half acres of wetland habitat. That disposal area, known as the Centennial site, is owned by a subsidiary of Rise Gold called Rise Grass Valley.

The Centennial site was polluted enough to warrant consideration for listing as a federal Superfund site, but Rise Gold avoided federal regulation by agreeing to undertake its own cleanup. Ralph Silberstein, the president of the Community Environmental Advocates Foundation, a local environmental organization, says his group welcomes Rise Gold's plan to address the hazardous substances that currently mar the area. But, he says, the group is troubled by what might come next. According to Rise Grass Valley's Remedial Action Plan, the company may take the freshly cleaned-up site and use it for dumping waste from "future mining operations," though it'll first have to get permission from the state.



Grass Valley's Idaho-Maryland Mine, abandoned for nearly 70 years, is marked by a weathered concrete silo. (Becki Robins)

Rise Gold's plans to minimize the mine's impact are outlined in a draft environmental report, which Nevada County recently released, and which the company describes as "favorable." In an interview with *Undark*, Rise Gold's CEO, Ben Mossman, defended his company's plan to use the Centennial site for some of the waste produced in conjunction with the reopening of Grass Valley's Idaho-Maryland Mine. This particular mine is unique, said Mossman, because the company found "very little metal content" in the areas where it plans to dig. Because the waste will largely consist of nontoxic materials such as sand and rock, he said, "there's no geochemical concerns to the environment or human health"—a claim that activists question.

Even when rock has little or no heavy metals, disposing of it can be a significant challenge. According to Rise Gold's website, the Idaho-Maryland mining operation historically had to remove a ton of rock for every half ounce of gold it recovered. "These mining companies come along and they want us to not notice that they're going to have a huge

amount of mine-waste rock,” says Elizabeth Martin, who recently retired as CEO of the Sierra Fund, a local conservation group based in nearby Nevada City. Rise Gold’s draft environmental-impact report says the plan will result in approximately 182,500 tons of material produced per year that will need to be transported and then used as engineered fill. By comparison, a large dump truck can carry about 14 tons. Multiply that by more than 10,000, and the visual is “beyond most people’s imagination,” says Martin.

Rise Gold plans to reduce its aboveground footprint at the Grass Valley mine with cemented-paste backfill, which was first used in the 1970s as a way to recycle mine materials and help stabilize the underground workings. In essence, the mine becomes safer and the waste goes back to where it came from.

Paste backfilling is widely regarded as a more environmentally friendly way to dispose of mine waste. There is evidence that locking tailings up in cement decreases their permeability and stabilizes any heavy metals within them. There are still questions, though, about whether or not arsenic and heavy metals will stay put in the paste-backfill material over the long term. The leaching behavior of arsenic depends on a lot of different factors, including the binder used in the backfill and the chemical content of the tailings. The biggest unknown is what happens in the future, when the mine closes and the pumps shut down, which will let groundwater flow into the backfilled tunnels. Some studies have noted that even low levels of leaching could continue for years, potentially contaminating drinking water or nearby rivers and streams.

Heavy-metal leaching is high on the list of concerns in Grass Valley. Rise Gold promises that its operations will be clean, but even so, the company’s hydrology report does note arsenic leaching from some test samples. The leaching tests, meant to simulate what might happen to a waste-rock pile when it rains, found that arsenic leached from samples of the mineral type serpentinite at concentrations 17 times greater than the

water-quality standards. Rise says that's not a concern, because there will be very little serpentinite in the waste rock. Its report also notes that tests on tailings indicated arsenic leaching, but only at concentrations that would not exceed regulatory limits.

Underground mining operations also intersect with the water table, which means the existing tunnels have to be dewatered, and the water that's pumped out of the tunnels has to be treated before it's released aboveground. "The water coming from these mines that they're dewatering is full of arsenic, manganese, iron, and other heavy metals," says the biologist Josie Crawford, the executive director of the Wolf Creek Community Alliance, another local group that opposes the mine. "It will be treated, but it needs to be treated forever."

The water also has to go somewhere after it's been treated. Rise Gold plans to flush it down nearby South Fork Wolf Creek, a move that Crawford fears could cause damage to the riparian habitat. "It's a trout stream, so it's sensitive," she says. "If the dewatering starts scouring the creek, they could lose a lot of those invertebrates and ruin the trout habitat."

Many conservationists and community opposition groups see gold mining as a battle between nature and greed, and question whether the pursuit of gold is really worth so much environmental destruction. So does Baur, the financial economist, who says it makes sense from both an environmental and economic perspective to just not mine for gold at all. Much of the gold that already exists aboveground, he says, is held by banks and investment companies. Investors can buy shares of gold they've never even seen. Baur says that they might as well just buy shares of gold that companies promise to leave in the ground. "You buy something that doesn't disrupt the land as much," he says, "and you don't have all the negative effects of the actual gold mining."

Baur recently explored this idea with a couple of his colleagues at the University of Western Australia Business School. In a 2021 paper, they proposed leaving unmined gold in the ground and letting “nature act as a natural vault and custodian legally protected by gold firms and the government.” In this scenario, investors could buy stock in gold-exploration companies that have identified underground gold but have no plans to mine it. This would give investors an alternative to purchasing shares of the aboveground gold that currently sits in bank vaults around the globe.

Would the unmined gold, which the paper calls “green gold,” actually earn money for its investors? Baur and his co-authors considered the costs of gold exploration and gold mining, and the uncertainty of the quality and amount of gold that might exist in any given underground location. They then ran an empirical analysis, and concluded that unmined gold can still be a valuable investment.

Baur says that his paper has, unsurprisingly, received negative feedback from the gold industry. “They hate the idea, of course,” he says. “It’s the end of their business, essentially.” He thinks investors, though, may be more willing to entertain the idea, especially those who are looking for green investments. “But there’s also a lot of greenwashing,” he says, adding that investors may say they want to invest green, but may not be as willing to try new ideas when the time comes.

These questions will take time to sort out. In the meantime, the Grass Valley mining project still needs to overcome public opposition and significant financial hurdles. Opening a mine is expensive. Before Rise Gold bought the mineral rights in 2017, EmGold Mining Corporation had plans to reopen the mine. It spent \$1 million just on consultants, according to one estimate, and the project never got past the preliminary stages. Locals such as Silberstein hope that Rise Gold’s plans will meet a similar fate.

“They’re talking about bringing gold up from 3,000 feet below the surface,” he says, “which means restoring a badly damaged, probably collapsed-in gold mine to get less than an ounce per ton of gold out.”

“It doesn’t make sense,” he adds. “It’s not a smart thing to do if we want to have a sustainable, livable world.”

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