

SUPPORTING SOUND MANAGEMENT OF OUR MINERAL RESOURCES

Rivers of Gold—Placer Mining in Alaska

Of all the gold ever mined in the world, approximately 1 to 2% (more than 33 million ounces) has come from Alaska. Seventy-two percent of this Alaskan gold was mined from placer deposits—gold accumulations in sands and gravels mostly deposited by streams and rivers. The U.S. Geological Survey (USGS) has worked in Alaska since 1889, helping to provide the scientific data necessary to manage the State's gold and other mineral resources.



The Mosquito Fork of the Fortymile River was near the heart of gold-mining activity in Alaska during the time of the Klondike Gold Rush of the late 1890's. Although the focus of Alaska's gold-mining industry has shifted elsewhere in the State, recent U.S. Geological Survey (USGS) studies indicate that gold still remains to be found in the Fortymile region. Inset photo shows a USGS scientist using time-honored methods to check Alaskan stream gravels for the presence of gold and other heavy minerals.

In 1896, George Washington Carmack and his Native American brothers-in-law, Skookum Jim and Tagish Charlie, found rich deposits of gold in the sands and gravels of a tributary of the Klondike River in the Yukon Territory of Canada. Their discovery started the stampede that became famous as the Klondike Gold Rush of 1897–98. In the summer of 1898, tens of thousands of would-be miners struggled over Chilkoot and White Passes into the Klondike region only to find that the gold-rich streams already had mining claims staked along their lengths. Some of these fortune-seekers turned back in disappointment, but many pushed on down the Yukon River into the nearby Alaskan interior in their quest for gold.

Gold discoveries made by these miners helped launch what is an important industry in Alaska. Although gold in the 1890's was used mainly in coins, jewelry, and decoration, its superior electrical conductivity and resistance to corrosion have since made gold a critical element in electrical and other components used in aircraft, spacecraft, telecommunications equipment, and computers. Even before the Klondike discoveries, Congress recognized the need to evaluate Alaska's mineral resources. In 1895, they appropriated funds that enabled the U.S. Geological Survey (USGS) to conduct its first major expeditions into Alaska's interior to study gold

and other mineral deposits.

Most gold mined in Alaska comes from the sands and gravels of streams and rivers. Sands and gravels that contain accumulations of gold or other minerals, such as platinum, diamond, ruby, and sapphire, are called placers. When rock material is broken down and transported by water, minerals such as these, which are heavier than other rock particles, tend to lag behind and be concentrated in placers. As much as two-thirds of the gold ever mined may have come from placer deposits; the rest has come from bedrock ore deposits, called lodes.

Some placer gold in Alaska occurs in beaches, like those along the coast at Nome, but most is found as flakes and nuggets in stream deposits. Stream placers are created by the repeated reworking of sands and gravels.

As gold-rich rock material is eroded and brought into a stream, it is broken down into smaller and smaller pieces, and the lighter particles are washed away by floods and normal streamflow. Because of its weight, however, gold lags behind and is concentrated in the bottom part of stream deposits. Gold particles are deposited in streambeds where water slows down, such as the insides of rivers bends, deep pools downstream from rapids, and the downstream sides of large boulders. Eventually, sufficient gold may accumulate to create a deposit rich enough to be profitably mined.

As much as 90% of gold recovered from stream placer deposits is found in the lowermost 3 feet of gravel and in cracks and holes in the uppermost foot of bedrock. Gold nuggets are rare. Most placer gold is in the form of flattened frag-



The action of streams can create gold-rich sands and gravels called placers. As gold-bearing rock material is broken down and washed away, gold (which is heavier than other mineral particles) lags behind and is deposited where water slows down, such as the insides of rivers bends, deep pools downstream from rapids (inset), and the downstream sides of large boulders. As much as 90% of gold recovered from stream placers is found in the lowermost 3 feet of gravel and in cracks and holes in the uppermost foot of bedrock.

Locations of Some Important Events in the Early Gold Mining History of Alaska



- 1834** Party of Russian-Americans under Malakoff reports finding gold in the Russian River drainage of the Kenai Peninsula.
- 1867** Alaska purchased from Russia and officially handed over to the United States in a ceremony at Sitka.
- 1880** Gold discovered near Juneau, both in the Silver Bow Basin and on Douglas Island.
- 1886** Gold found in the Fortymile River, the first major gold discovery in the interior of Alaska.
- 1893** Gold discovered on Birch Creek in an area that later became famous as the Circle Mining District.
- 1896** George Washington Carmack, Skookum Jim, and Tagish Charlie find rich deposits of gold on a tributary of the Klondike River in the Yukon Territory of Canada, starting the Klondike Gold Rush.
- 1898** Miners from the Klondike continue down the Yukon to Alaska's Seward Peninsula and find gold at Nome. Others make finds in other parts of Alaska.
- 1902** Felix Pedro finds gold on a tributary of the Tanana River at the site what is now the city of Fairbanks.

ments or flakes less than 1/8 inch across. Although these fragments may have ragged edges and appear fresh, this does not necessarily mean that they were eroded from a source nearby. Rather, they may have been weathered or broken out of a rock, made up mainly of other minerals, such as quartz and feldspar, that had already traveled long distances downstream.

Until the late 1880's, placer gold in Alaska was mined only by simple labor-intensive methods, similar to those used for thousands of years. Miners dug and moved gold-bearing gravels with shovels, picks, and wheelbarrows. They then used water and hard work to wash and separate the gold from the gravel using gold pans and wooden sluiceboxes and rockers.

By the time of the Klondike Gold Rush, a new method had been developed that allowed miners to excavate gold-bearing gravels from deeper, permanently frozen ground (permafrost). By repeatedly building fires on permafrost and then excavating the thawed ground, miners were able to dig shafts and tunnels in gold-rich gravels as deep as 20 to 30 feet. This method was used mainly in winter, and the excavated gravels were stockpiled until the spring thaw. In the warm months, miners would use a sluicebox to separate gold from the gravels, a process called sluicing.

During the 20th century, repeated improvements in equipment allowed larger-scale mining of Alaskan gold placers. In the early decades, hoses with nozzles that emitted high-pressure streams of water were used to thaw and loosen huge quantities of gravel for sluicing, a process called hydraulic mining. By the 1930's, the introduction of steam-powered shovels, scrapers, and bucketline dredges further energized the placer mining industry in Alaska. Later, the use of diesel powered bulldozers, pumps, and other equipment, as well as the development of durable steel sluiceboxes, enabled miners to process such vast amounts of material that they could economically extract gold from even poorer grade gravels. In the last 20 years, further advances in equipment and techniques have greatly increased the efficiency of placer gold mining in Alaska.

As placer-mining methods evolved, concerns about environmental effects led to changes in the gold-mining practices and regulations used in Alaska. In 1980, the price of gold on the world market had risen sharply and reached an all-time high of \$850 per ounce, creating an economic incentive that resulted in a large increase in placer mining in Alaska. This increase brought attention to the environmental impacts of mining on the State's water quality and clarity, commercial and



Atwater Dredge mining placer gold from gravels on the Fortymile River in east-central Alaska about 1912. Inset photo shows a 19th-century miner using a wooden rocker to separate gold from river gravel. (Dredge photo courtesy of Eagle Historical Society, Eagle, Alaska; inset photo courtesy of University of Alaska, Fairbanks.)

sport fishing industries, and on the scenic beauty that attracts thousands of tourists each year.

In part using data gathered by the USGS and the Alaska Division of Geological and Geophysical Surveys during the past century, the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation developed guidelines that now regulate mining in the State. Today, Alaskan placer mines are required to have settling ponds to catch the muddy runoff from the processing of gold-bearing gravels, and many placer miners are recycling the wastewater generated by their gravel-washing operations.

Meeting the challenge of balancing America's needs for both nonrenewable resources and a clean and healthy environment requires accurate and unbiased scientific data. The ongoing work of scientists with the USGS Mineral Resources Program in Alaska and elsewhere in the United States provides the information crucial to the creation of sound policies that will ensure future supplies of mineral resources while protecting the health of our Nation's citizens.

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see also Gold placers of the historical
Fortymile River region, Alaska:
U.S. Geological Survey Bulletin 2125, 1996.