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METALLIFEROUS RESOURCES OF UTAH

by

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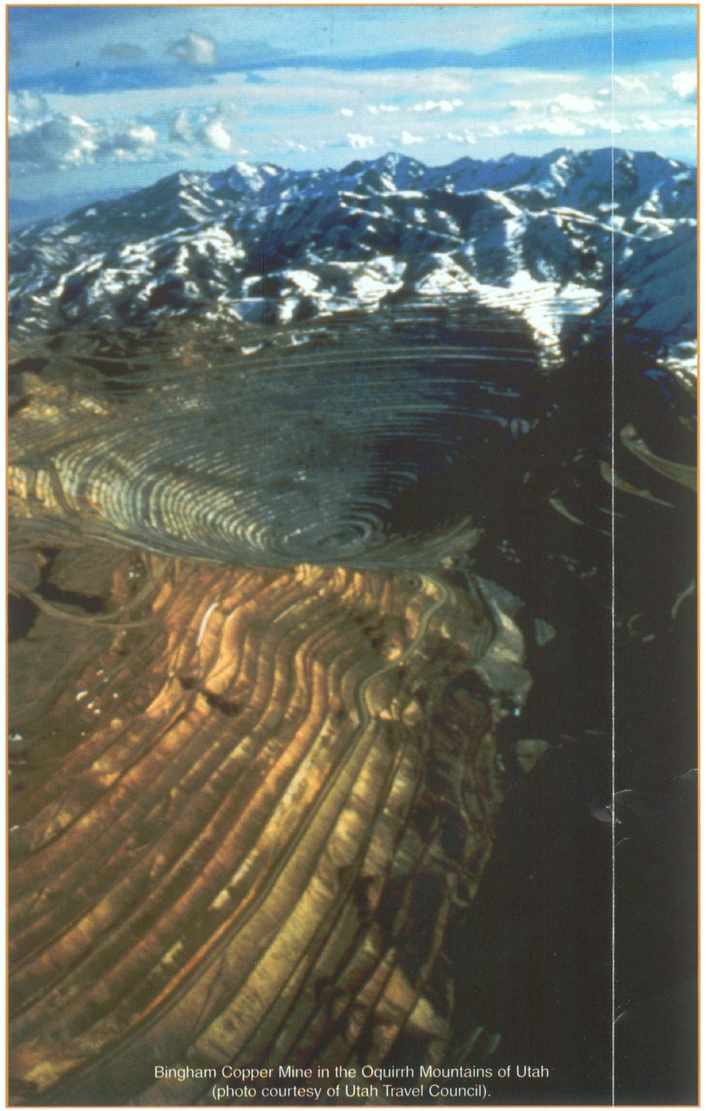
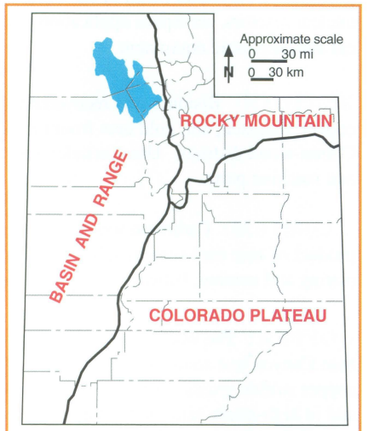
IN THE PAST BILLION YEARS OR SO...

During the past billion years, geologic events and processes have created Utah's diverse mineral resources. These events and processes include mountain building and erosion, magmatic intrusion, and hot fluids circulating in the crust. Because these forces were not uniform across the state, they created three distinct geologic or physiographic provinces, each with its own suite of minerals. The unique geologic history and collection of minerals for each of these provinces, Basin and Range, Colorado Plateau, and Rocky Mountain, are discussed below.



Bingham Copper Mine in the Oquirrh Mountains of Utah (photo courtesy of Utah Travel Council).

THE BASIN AND RANGE PROVINCE



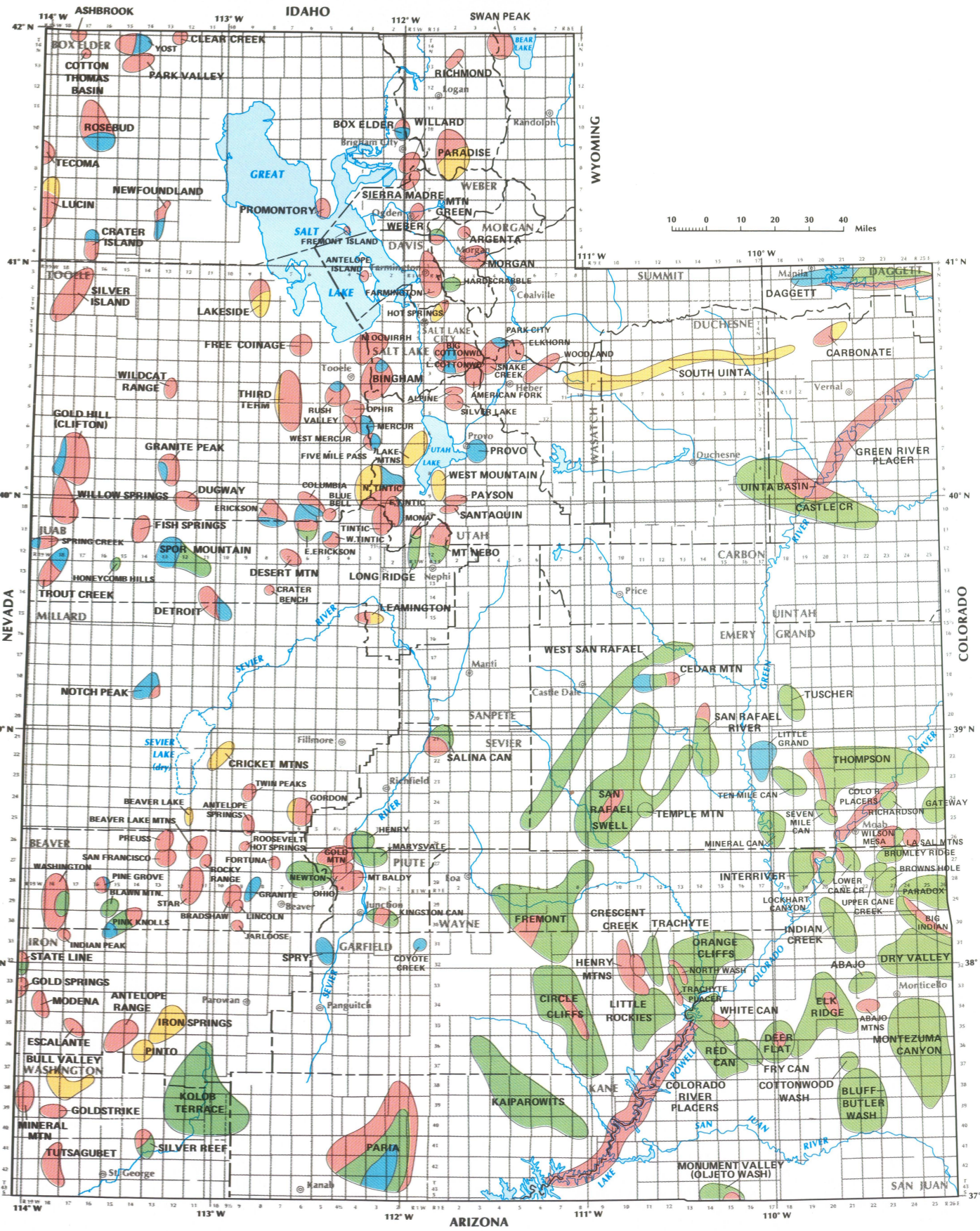
Physiographic Province Map of Utah

The Basin and Range province covers western Utah and is characterized by steep, narrow mountain ranges separated by wide, flat, sediment-filled valleys. The rocks that form the ranges are commonly limestones and dolomites deposited approximately 240 to 570 million years ago in ancient tropical seas. These rocks were later uplifted, folded, and faulted. Between 20 and 40 million years ago magma intruded the crust in several places in western Utah. Hot-water solutions that accompanied the igneous activity introduced scattered particles of metallic minerals into the surrounding rocks, forming ore deposits. Starting about 15 to 20 million years ago, after much erosion, the area was broken into large blocks which were tilted to form today's mountain ranges and the valleys (basins) between them. The ore deposits of these ranges, exposed by erosion, are the source of precious and base metals worth billions of dollars. Most of Utah's metal production, except for vanadium, has come from the Basin and Range province. The Bingham district, southwest of Salt Lake City in the Oquirrh Mountains, has been the state's largest producer of copper, gold, silver, lead, and zinc. Other major sources of these metals in Utah's Basin and Range Province are the Tintic district in Juab County south of Bingham Canyon; the Gold Hill district in southwestern Tooele County; Rush Valley, Ophir, and Mercur in Tooele County; and the many districts in Beaver, Washington, Iron, and Piute Counties in the southwestern part of the state. Rich deposits of iron ore have been mined from limestone altered by granitic intrusions in the Iron Springs and Pinto districts of Iron County. Great Salt Lake, in the northern part of the Basin and Range province, is a remnant of Lake Bonneville that covered most of western Utah's basins approximately 15,000 years ago. As the area's climate became warmer and possibly drier, the water in ancient Lake Bonneville evaporated, leaving behind and concentrating its dissolved salts in the Great Salt Lake and Bonneville Salt Flats. Magnesium metal is produced from the magnesium chloride salt in Great Salt Lake brines.

THE COLORADO PLATEAU PROVINCE

The Colorado Plateau province covers the southeastern portion of Utah. In contrast with the Basin and Range, it is covered with a thick sequence of nearly flat-lying sedimentary rocks, very much like a layer cake. Most of these sandstones and shales are younger than the rock exposed in the mountains of the Basin and Range province and were deposited approximately 65 to 300 million years ago in deserts, river basins, lakes, and shallow seas. In the past 10 million years, the plateau has been uplifted as much as a mile and rivers have cut deep, narrow canyons through the sediments to create some of the most spectacular scenery in the world. The Colorado Plateau is rich in energy resources, but relatively few metalliferous ore deposits are present. Vanadium occurs with the many deposits of uranium found scattered throughout the Colorado Plateau sandstones. Low-grade copper mineralization is also found locally in the sandstones, and some minor gold-silver-lead mineralization is located in three granitic ranges which protrude through the sedimentary rocks: the La Sal, Abajo, and Henry Mountains. Small quantities of placer gold are dispersed along the Colorado River and its principal tributaries.

Uranium/Vanadium mine, Garfield, Utah (photo credit: U. S. Energy Corporation)



PRECIOUS AND BASE METALS (Gold, Silver, Copper, Lead and Zinc)

IRON

TINTIC / SILVER = **METALLIFEROUS AREA NAME**

RADIOACTIVE OCCURRENCES (Uranium, Thorium, including Vanadium)

MISCELLANEOUS METALS (Antimony, Beryllium, Bismuth, Manganese, Mercury, Molybdenum, Tungsten, etc.)

THE ROCKY MOUNTAIN PROVINCE

The Rocky Mountain province in northeastern Utah includes the east-west Uinta Mountains and the north-south Wasatch Range. These ranges contain very old rocks (up to 2.6 billion years), and are very high (up to 13,500 feet above sea level). Large basins adjacent to the ranges are filled with more than 10,000 feet of younger sandstones, shales, and unconsolidated sediments. The province also includes intrusive volcanic rocks. Small deposits of iron, manganese, copper, lead, and silver are found in the Wasatch and Uinta Mountains, and larger deposits occur where the two ranges meet. Here, massive 20 to 40 million-year-old volcanics provided mineralizing solutions for a group of mining districts, including Park City, Big Cottonwood and Little Cottonwood Canyons, famous for their production of silver, lead, and zinc.

Ontario Mines circa 1881, Park City, Utah. Photo by C. R. Savage.

IMPORTANT METALS FOUND IN UTAH

Utah's mineral resources have played an important part in the development of Utah's economy since 1870. Historically, the most important metal production has been copper, lead, silver, gold, zinc, and iron, in this order. Due to advances in metallurgy, iron-alloying metals such as vanadium and molybdenum became important after World War II. The world's largest excavation, Kennecott's Bingham Canyon open-pit mine, yields large quantities of copper, gold, silver, and molybdenum. The world's largest beryllium resources were discovered in the state in 1960, and magnesium metal was first recovered commercially from the brine of Great Salt Lake in 1972.

The metallic resources produced or known to be present in Utah are:

ANTIMONY: Antimony is found with copper, lead, and zinc ores at Bingham Canyon, Park City, and Tintic mining districts. Low-grade deposits of stibnite (antimony sulfide) are found in Box Elder, Garfield, and Washington Counties. Uses include: flame retardants, batteries, ceramics, glass, and chemicals.

ARSENIC: Arsenic is found with copper, lead, and silver ores. It was recovered from smelters until 1960. Large amounts are found at Gold Hill in western Tooele and Juab Counties. Uses include: preserving wood, herbicides, and desiccants.

BERYLLIUM: The world's largest known beryllium resource is in Juab County. Bertrandite ore (beryllium silicate) is found in volcanic tuff northwest of Delta. Beryllium is a very light-weight metal, even lighter than aluminum. Utah continues to be the leading producer of beryllium metal in the United States. Uses include: nuclear reactors, aerospace applications, and as an alloy for electrical and electronic equipment.

BISMUTH: Bismuth was recovered as a by-product of lead, copper, tungsten, and gold ores from the Tintic, Gold Hill, and Cotton-wood districts. Uses include: pharmaceuticals, chemicals, and machine parts.

CADMIUM: Cadmium was recovered from smelters as a by-product of zinc ores such as sphalerite (zinc sulfide). Uses include: plating and coating, batteries, pigments, and plastics.

COPPER: The world's largest open-pit copper mine is at Bingham Canyon just southwest of Salt Lake City. The copper occurs in copper sulfide grains scattered through volcanic and intrusive rock and in high-grade veins and replacement bodies in the limestones around the intrusive rock. Copper has been produced from about 50 mining districts in Utah, most in the western part of the state. Some copper is associated with uranium and vanadium in sandstones in the Colorado Plateau. Uses include: building construction, electrical and electronic products, and industrial machinery.

GALLIUM AND GERMANIUM: Gallium and germanium were mined from the Apex mine in Washington County, and are found as a minor constituent of copper-lead-zinc ore. Uses include: electronics, fiber optics, semiconductors, metallurgy, and chemotherapy.

GOLD: Much of Utah's gold production has been as a byproduct of copper-lead-zinc ore, especially from Bingham Canyon. North of Bingham Canyon, the Barney's Canyon mine is currently the state's largest primary gold producer. Some of Utah's gold has been recovered from weathered near-surface veins. One large placer gold deposit was found in Bingham Canyon in 1864 and other smaller placers were found along the Colorado River and its tributaries. Utah usually ranks second or third in production of gold in the United States. Uses include: jewelry, arts, electronics, dental, and coinage.

IRON: High-grade iron ore is found in many small deposits in the Wasatch and Uinta Mountains, but large deposits are found only in southwestern Utah. For many years iron ore has been mined at the Iron Springs district in Iron County, where it occurs as magnetite and hematite replacements of limestone around a granitic intrusion. Uses include: pig-iron, steel making, and cement.

LEAD: Lead occurs as lead sulfide (galena) and is usually mined with silver in lode ores (see Silver). Uses include: batteries, construction, ammunition, electrical, glass, and ballast.

MAGNESIUM: Magnesium metal is produced from the brine of Great Salt Lake. Uses include: light-weight aluminum alloys, magnesium castings, and dust suppressant.

MANGANESE: About 50 deposits containing small amounts of manganese are known in Utah. The greatest production in the past was from the Tintic, Erickson, and Detroit districts in west-central Utah, where it occurs as manganese carbonate. In contrast, the Little Grand deposit of Grand County contains manganese oxide in veins and stringers in sandstone. Uses include: a steel alloying agent and a chemical.

MERCURY: A small amount of mercury has been produced from four mines in western Utah. The state's largest production was from the Mercur district where cinnabar (mercuric sulfide) was found with gold. Uses include: electrical equipment, chemicals, for production of chlorine and caustic soda, and paints.

MOLYBDENUM: Utah has been a major producer of molybdenum since 1936, when it was first recovered as a by-product of copper at Bingham Canyon. A small amount has been produced from other lode mining districts and some is associated with uranium deposits. Uses include: a steel alloying agent, a lubricant, chemicals, and electrical equipment.

RARE EARTH ELEMENTS: These include the lanthanides, actinides, yttrium, and scandium. They occur in pegmatites, tuffaceous rocks, and rhyolites in western Utah and in Upper Paleozoic black shales and phosphatic shales in northern Utah. Rare scandium minerals occur as hydrothermal deposits near Mercur, Utah. Uses include: petroleum catalysts, glass, ceramics, permanent magnets, laser crystals, and superconductors.

SELENIUM: Selenium is found in copper and lead ores at Bingham Canyon, in the black shales of the Phosphoria Formation and other black shales of Utah, and in some uranium deposits. Uses include: electronic and photocopier components, glass, chemicals, and pigments.

SILVER: Many of the metalliferous or lode deposits in western Utah contain a mixture of silver, lead, and zinc, with lesser amounts of copper, gold, and other minor metals. These deposits are found where the fluids from igneous intrusions have reacted with the surrounding rock, especially carbonates, to precipitate metallic sulfides in fractures and voids. The most important lode production in Utah has come from mining districts within 50 miles of Salt Lake City. Uses include: photography, electrical and electronic products, silverware, and jewelry.

TELLURIUM: Tellurium is recovered as a minor constituent of copper ore from Bingham Canyon. Uses include: iron and steel products, and chemicals.

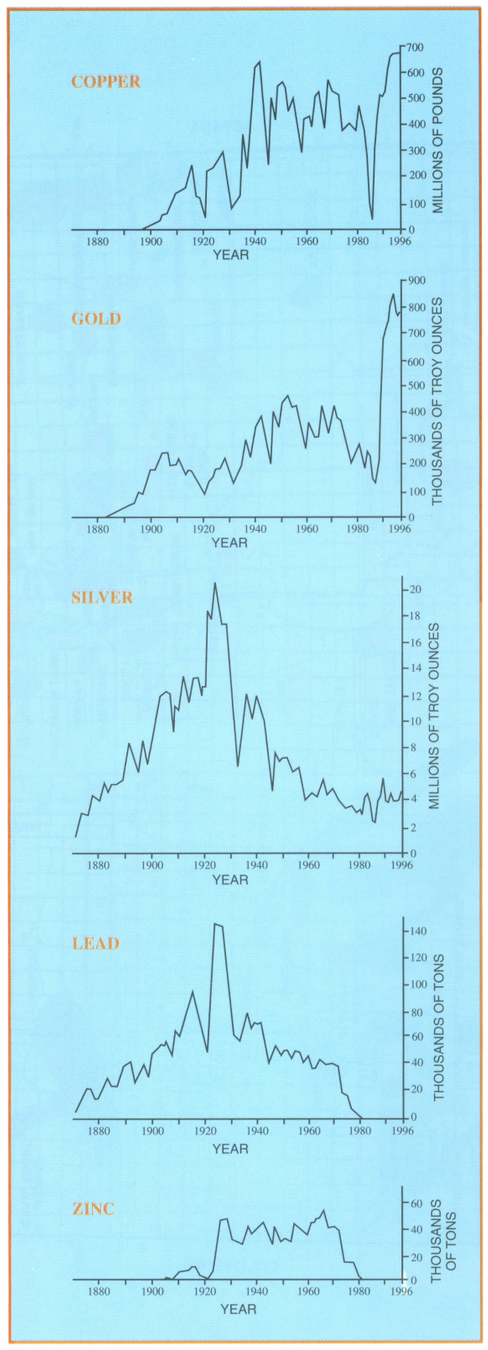
TITANIUM: Titanium occurs in accessory minerals in granitic rocks and in "black sand" deposits. Utah has small deposits but no reported production near Lucin in western Box Elder County and in Emery, Garfield, and Kane Counties. Uses include: jet engines, air frames, space applications, chemical processing, power generation, and paint.

TUNGSTEN: Western Utah has a number of small, low-grade scheelite (calcium tungstate) deposits which are mined when prices are high. Tungsten forms at the contact between granitic intrusive rocks and limestones. Uses include: metal working, mining, construction machinery, electrical machinery, and lighting.

URANIUM: Uranium is produced first for its radium content, then for the vanadium associated with it. Thousands of occurrences have been found in southeastern Utah in the sandstones of the Colorado Plateau. Some occurrences have also been found with lode deposits related to volcanic activity and granitic intrusions. Uses include: munitions and power plants.

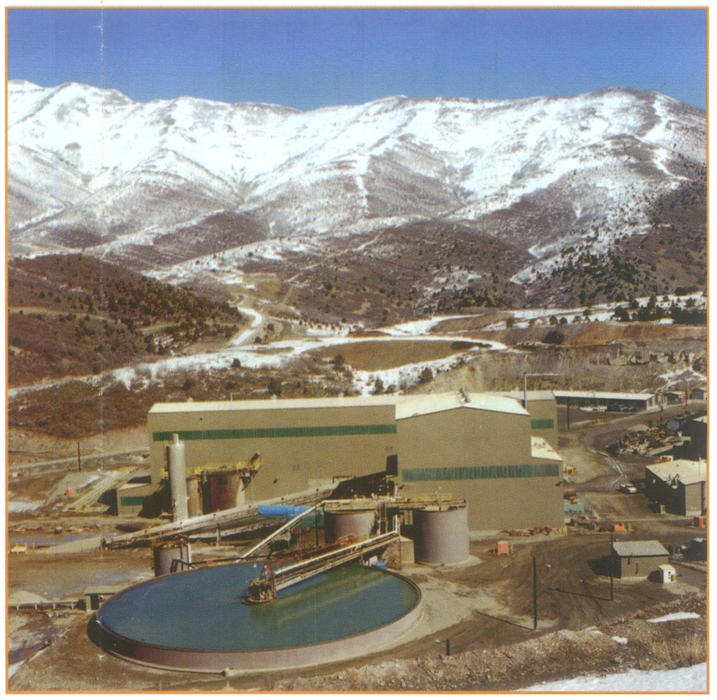
VANADIUM: Vanadium occurs with uranium in the Colorado Plateau (see Uranium). Uses include: hardens steel utilized in construction, machinery, and transportation.

ZINC: Zinc occurs with lode ores that are usually mined primarily for their silver and lead content (see Silver). Uses include: chemical, agricultural, rubber, and paint industries.

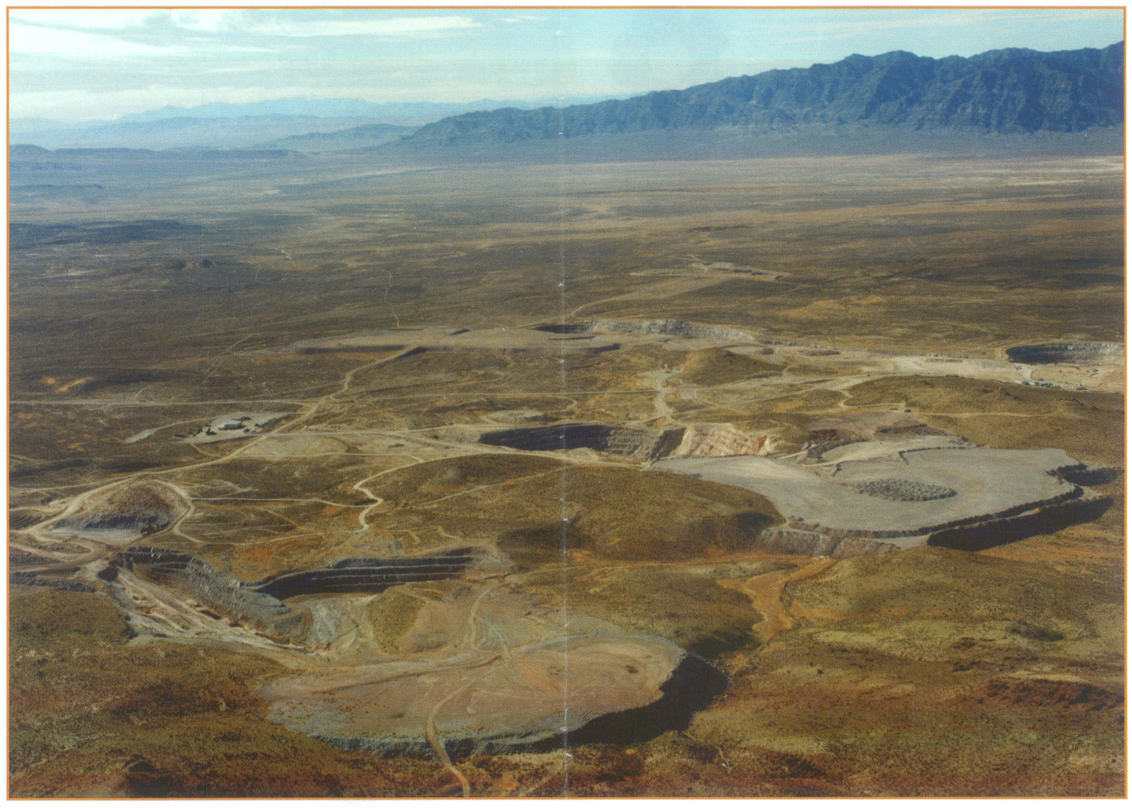


Copper, gold, silver, lead, and zinc production in Utah.

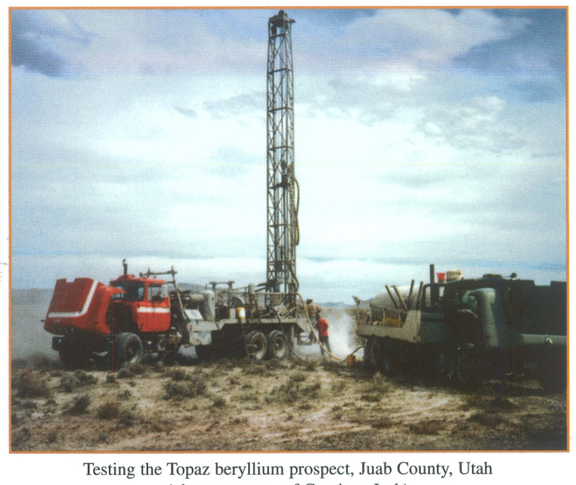
Brush Wellman beryllium-processing plant near Delta, Utah.



Mill and slurry tank of Barrick Mercur gold mine, Tooele County, Utah (photo courtesy of Barrick Mercur Gold Mines, Inc.)



Beryllium mines near Delta, Millard County, Utah (photo courtesy of Brush Wellman, Inc.)



Testing the Topaz beryllium prospect, Juab County, Utah (photo courtesy of Cominco Ltd.)

SELECTED REFERENCES

Mineral and water resources of Utah, 1964, Utah Geological and Mineral Survey Bulletin 73.

Mineral commodity summaries, published yearly by the U.S. Bureau of Mines and the United States Geological Survey.

Summaries of Mineral Activity in Utah, published by the Utah Geological Survey.

United States Mineral Resources, 1973, United States Geological Survey Professional Paper 820.