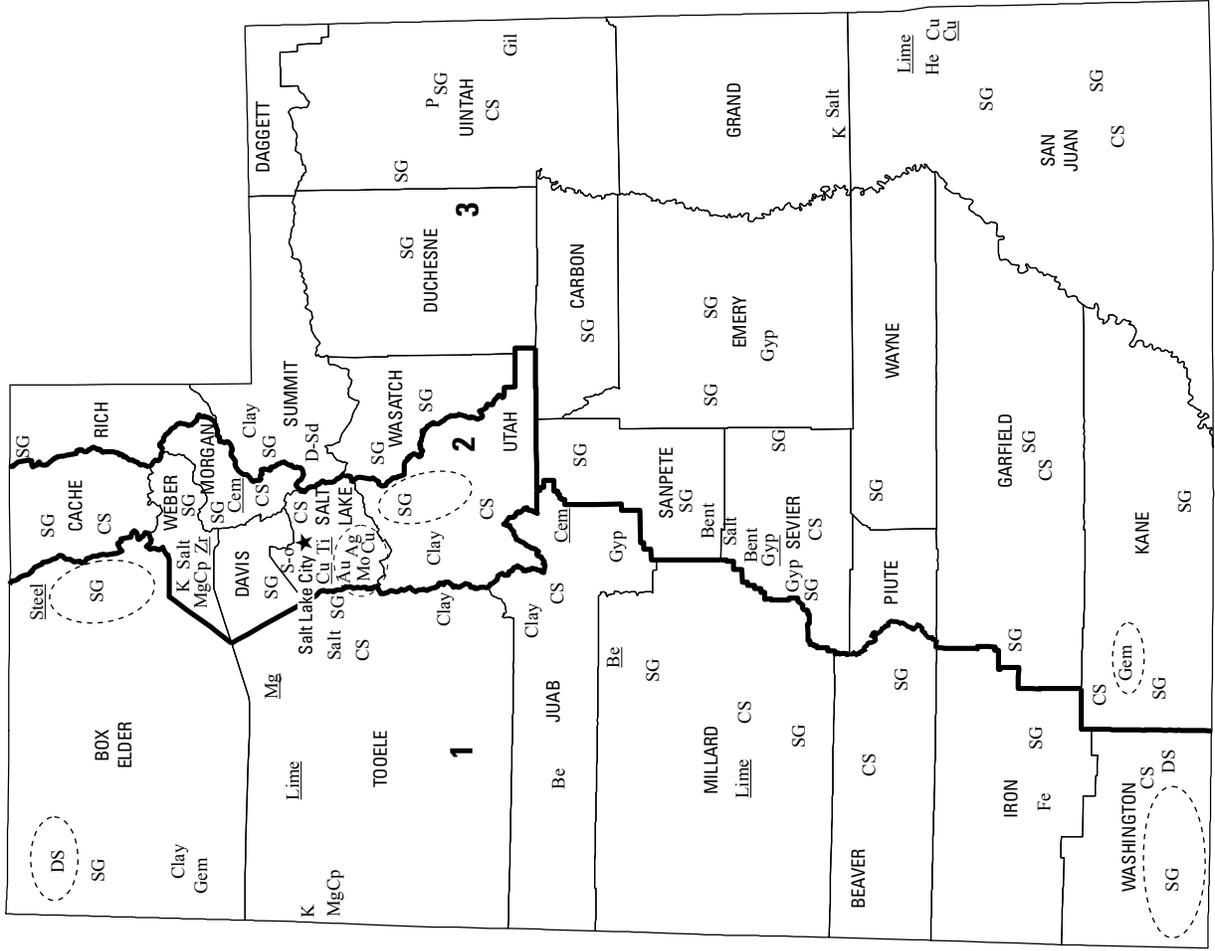




2008 Minerals Yearbook

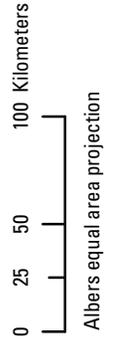
UTAH

UTAH



LEGEND

- County boundary
 - ★ Capital
 - City
 - Crushed stone/sand and gravel district boundary
- MINERAL SYMBOLS
(Principal producing areas)**
- | | | | |
|------|-------------------------|-------|-------------------------------------|
| Ag | Silver | D-Sd | Dimension sandstone |
| Au | Gold | Fe | Iron |
| Be | Beryllium | Gem | Gemstones |
| Be | Beryllium plant | Gil | Gilsonite |
| Bent | Bentonite | Gyp | Gypsum |
| Cem | Cement plant and quarry | Gyp | Gypsum plant |
| Clay | Common clay | He | Helium |
| CS | Crushed stone | K | Potash |
| Cu | Copper | Lime | Lime plant and quarry |
| Cu | Copper plant | Mg | Magnesium metal plant |
| DS | Dimension stone | MgCp | Magnesium compounds |
| | | Mo | Molybdenum |
| | | P | Phosphate rock |
| | | Salt | Salt |
| | | SG | Construction sand and gravel |
| | | S-o | Sulfur (oil) |
| | | Steel | Steel plant |
| | | Ti | Titanium metal plant |
| | | Zr | Zirconium metal plant |
| | | ○ | Concentration of mineral operations |



THE MINERAL INDUSTRY OF UTAH

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Utah Geological Survey for collecting information on all nonfuel minerals.

In 2008, Utah's nonfuel raw mineral production was valued¹ at \$4.16 billion, based upon annual U.S. Geological Survey (USGS) data. This was a \$280 million, or 7.2%, increase from the State's total nonfuel mineral value of \$3.88 billion in 2007, which was down \$130 million, or down 3.2%, from that of 2006. The State remained fourth in rank among the 50 States in total nonfuel mineral production value and accounted for 5.9% of the U.S. total value.

Metals accounted for 75% of Utah's nonfuel mineral production value. The State's total nonfuel mineral production value increased principally owing to \$2.3 billion in the combined value of copper, magnesium metal, and potash (individual values withheld—company proprietary data). In 2008, substantial increases also took place in the production values of gold, gypsum, lime, magnesium compounds, phosphate rock, and silver for a combined value of \$86 million (individual values withheld—company proprietary data).

In 2008, Utah continued to be the only State to produce beryllium concentrates and magnesium metal. The State was second in the quantity of copper, molybdenum, and potash produced. Utah was third in the quantity of gold and fourth in silver production. The State rose to second from third in the quantity of magnesium compounds and bentonite clay produced. Utah remained 10th in the production of lime. The State dropped to seventh from sixth in salt production. Additionally, the State was a producer of significant quantities of construction sand and gravel, portland cement, crushed stone, dimension stone, phosphate rock, and common clays.

The Utah Geological Survey² (UGS) provided the following narrative information. UGS production data were based upon its surveys, estimates, and information gathered from company annual reports. These data may differ from some USGS annual production figures, which were based upon USGS company surveys and estimates.

Industry Overview and Trends

Overall, the value for industrial minerals was expected to decline as Utah's economy continued to contract. There were

¹The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity.

All 2008 USGS mineral production data published in this chapter are those available as of July 1, 2010. All USGS Mineral Industry Surveys and USGS Minerals Yearbook chapters—mineral commodity, State, and country—can be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals>.

²Kenneth Krahulec, Geologist, and Roger Bon, Industry Outreach Specialist, of the Utah Geological Survey authored the text of the State mineral industry information provided by that State agency.

many exploration activities for uranium. The reopening of several mines and the opening of a second uranium mine may be tempered by a sharp decline in spot uranium prices. This new uranium mining activity was expected to add significantly to Utah's energy minerals economic sector. The construction of a titanium sponge plant adjacent to U.S. Magnesium LLC's magnesium facility on the west shore of Great Salt Lake was expected to add incremental demand for magnesium and was expected to begin a new era in metal processing in Utah. One new iron mine was in development, but did not ship ore in 2008, and one new copper mine was in development with first production scheduled for early 2009. Utah was rated as the 11th-best (down from 4th best, in the 2007 survey) regulatory environment for mining in the 2008 Fraser Institute Survey of Mining Company's Policy Potential Index.

Exploration and Development Activities

During 2008, the Utah Division of Oil, Gas and Mining (DOG M) received 4 new large mine permit applications for 2-hectares (ha) and larger disturbance and 24 new small mine permit applications of less than 2-ha disturbance. Sixty-four notices of intent to explore on public lands were filed with the DOGM in 2008, compared to 53 in 2007 and 35 in 2006. More than 6,000 (down from 15,000 in 2007) new Federal unpatented mining claims were recorded by the Bureau of Land Management (BLM). The Utah School and Institutional Trust Lands Administration signed contracts on 196 tracts of land during the year. In 2008, the DOGM approved 24 small mine permits, and 27 exploration notices of intent to mine permits. The 24 small mine permit applications were for the following: industrial minerals—12; energy minerals—10; precious-metals—1; and gems, fossils, and other—1. Exploration notices of intent were dominated by energy minerals—19, followed by base metals—4, precious metal—2, and industrial minerals—2.

Mineral exploration and development work continued at a brisk pace in Utah during 2008. Most efforts focused on copper, gold, molybdenum, silver, uranium, and zinc. Commodity prices reached the peak in mid-2008 and collapsed late in the year. Metal prices, which had been on a 5-year increase, reached near-historic highs in mid-2008, but rapidly declined in the second half of the year. This rise in metal prices led to substantially increased mineral exploration and development in the State. In addition to the initiation of mining at several uranium mines in San Juan County, advanced-stage exploration and development was ongoing in the Iron Springs iron and Rocky Range-Beaver Lake copper-gold and the copper-gold mining districts.

The information in this section is largely derived from numerous individual company Web sites and press releases. The number of unpatented mining claims filed in Utah rose

dramatically in recent years from a low of 508 in 2001 to more than 6,000 in 2008. Many unpatented mining claims filed in Utah were staked for uranium on the Colorado Plateau. San Juan County recorded the most mining claims with more than 1,000, followed by Wayne, Grand, Juab, Beaver, and Emery Counties, all with more than 500 claims each. The Utah School and Institutional Trust Lands Administration (SITLA), which manages about 1.8 million ha of State-owned lands in Utah, issued leases and/or contracts on 196 tracts in 2008. The leases and/or tracts were divided among the following commodities: bituminous/asphaltic sands—3, clay—1, coal—3, geothermal—39, gypsum—2, building stone—1, humic shale—4, metalliferous minerals—63, mineral materials—12, oil shale—5, potash—42, and sand and gravel—21. Buoyed by near-record metal prices, base metals had another strong year in Utah. Metal prices peaked in June 2008 and fell precipitously later in the year. Another copper mine near Milford and an iron mine near Cedar City were poised to begin production in 2009. The Lisbon Valley solvent copper extraction-electrowinning (SX-EW) operation, southeast of Moab, declared bankruptcy.

Kennecott Utah Copper Corporation's Bingham Canyon Mine earned \$1 billion in 2008. Higher metal prices were offset by lower tonnages and higher unit costs. Bingham remained the U.S.'s second largest producer of both copper and molybdenum. Kennecott is in the fifth year of an aggressive development program with efforts concentrated on extending the mine life plan from 2019 to 2036. Kennecott's development work increased the resource at the mine by 692 million metric tons (Mt) averaging 0.48% copper, 0.032% molybdenum, and 0.18 parts per million (ppm) gold. Alternative future mine plans being studied included open pit laybacks and/or various underground options. Five underground options were being studied; four were porphyry copper-molybdenum block caves on deep porphyry roots beneath an existing open pit, and another is a higher grade copper-gold skarn resource. Kennecott announced plans for construction of a \$270 million molybdenum autoclave process facility. The facility was expected to convert molybdenite concentrates to molybdenum trioxide and ammonium dimolybdate. The new facility was expected to have the capacity to produce 13.6 million kilograms (kg) of molybdenum products and an additional 4,090 kg of rhenium per year. The project was delayed by low metal prices, but may be restarted. Kennecott announced that they recently identified a world-class molybdenite deposit under the current pit. Kennecott continued exploration in their Brownfield site that included running 157 line-kilometer of induced polarization surveys. Magnetotelluric surveys and additional airborne magnetic surveys were flown over portions of the Oquirrh Range that had not been previously covered. Six deep holes totaling 5,580 meters (m) were completed in the Bingham area south and west of the Bingham pit. The analytical results were not yet released.

In the Iron Springs region, Palladon Iron Corporation/Iron Bull Mining & Milling (Iron Bull) acquired the Iron Mountain property (former Comstock-Mountain Lion open pit), which hosts an estimated resource of 16 Mt averaging 52% iron. The ore occurs as massive magnetite replacement/skarn deposits adjacent to Miocene laccoliths. In 2008, Iron Bull installed a

power substation, a crusher, a radial stacker, and a rail load out. The company upgraded the rail spur and began mining. Iron Bull plans to ship the ore directly to China without concentrating it. The first ore shipment was delayed by the congestion at the west coast port.

In the Tintic District, Andover Ventures/Genco Resources purchased 65% of the Chief Consolidated Mining Company. Chief Consolidated's main assets were in the East Tintic district, Utah County. Chief Consolidated applied for permits to renew operations at the Burgin Mine. The Burgin replacement deposit consists of more than one Mt high-grade silver-lead-zinc resource. In addition, Anglo American Exploration (USA), Inc. was drill testing a porphyry of copper-gold-molybdenum on Big Hill near the center of the district. Anglo American began drilling the target in late 2008, and the results were not available. Quaterra Resources, Inc.'s 1,300-ha property of patented and unpatented mining claims in the Southwest Tintic porphyry copper system hosts a known resource of approximately 360 Mt of 0.33% copper and 0.01% molybdenum. Silver Verde May Mining Company acquired 82 claims and a 259-ha State lease covering a porphyry copper-molybdenum system in the West Tintic mining district, Juab County. Silver Verde had an additional 40 claims and a 271-ha State lease on a sediment-hosted gold target on the south flanks of Maple Peak, in Juab County. In the Fish Springs mining district of western Juab County, Lithic Resources Ltd. owns the Crypto zinc skarn deposit. A 1993 Cyprus Minerals Company estimate indicated a shallow oxide resource of 2.8 Mt averaging 7.0% zinc and a deep sulfide resource of 5.4 Mt averaging 8.8% zinc. In 2008, Lithic completed a core drilling program aimed at confirming and expanding the historical zinc resource at Crypto. Reported intercepts include 23.9 m at 185 ppm indium and 30 m at 17.9% zinc. In the Rocky-Beaver Lake mining district, the Copper King Mining Corporation controlled about 37,200 ha in the Milford area and has been actively exploring the Rocky and Beaver Lake mining districts for the past several years. The districts host seven partially defined copper skarn and breccia pipe deposits. Current proven ore reserves total approximately 2.2 Mt averaging about 1.3% total copper with possible gold-silver credits. Copper King has stripped about 1.45 Mt of overburden from the Hidden Treasure skarn, stockpiled some ore, and is awaiting startup of a 2,270-metric-ton-per-day (t/d) flotation mill in early 2009.

Inland Explorations Ltd. was formed in 2006 specifically to conduct base-metals exploration in Utah. The company has aggressively pursued a grassroots exploration program and has acquired four properties to date—Keg, Dugway, Dunes (Sand Mountain), and Thompson Knoll. The target at the Keg property is a porphyry/skarn deposit. The Dugway target is a copper-lead-zinc-gold-silver carbonate-hosted replacement deposit on the southwest flank of the Dugway district. Thompson Knoll lies in the Confusion Range of west-central Utah. The Thompson Knoll targets are both skarns and sediment-hosted gold-silver, similar to that in the adjoining Kings Canyon deposit. Dunes is a base-and-precious-metal massive sulfide replacement target associated with gently dipping structures.

The Lisbon Valley Mining Company's open pit, heap leach, solvent extraction/electrowinning (SX-EW) copper operation

experienced metallurgical problems throughout 2007 and 2008 as it attempted to ramp up to full production. The recovery of copper from the pads was substantially slower than anticipated. Despite efforts to increase production, the operation continued to underachieve, and mining was suspended in early 2008. Approximately 15,900 t of copper was on the leach pads. Leaching of this material was expected to continue for the next 1 to 3 years. All exploration by Lisbon Valley on the Flying Diamond-Stateline resources and open pit operation stopped in 2008. Geoinformatics Exploration, Inc. purchased Kennecott Exploration's Stockton porphyry copper deposit in 2008. The deposit is about 16 km southwest of Bingham and hosts a resource, estimated by Kennecott, of approximately 172 Mt at 0.41% copper and 0.14 ppm gold beginning at a depth of about 225 m. The best new hole intersected 517 m, averaging 0.23% copper, 0.09 ppm gold, 1.1 ppm silver, and 0.01% molybdenum. The following were other base metal developments in Utah: (1) Kennecott Corp. staked more than 600 claims in the adjoining Ophir and Stockton mining districts, Tooele County; (2) RTM Exploration and Holdings LLC controlled about 777 ha of sediment-hosted copper-molybdenum prospects in the Uinta Basin; (3) International Beryllium Corporation acquired 371 claims adjacent to Brush Wellman's Spor Mountain beryllium mine, in Juab County; and (4) Unico, Inc. continued work on the Deer Trail zinc-lead-silver mine and mill near Marysvale in central Utah.

Strong prices for precious metals during 2007 and 2008 sustained the high level of gold and silver exploration activity in Utah. These efforts were largely focused in the eastern Basin and Range Province of western Utah. The Silver Dome property in the southern Fish Springs District is a 2,020-ha property acquired by Cordex for Columbus Gold Corporation, which later became the Columbus Silver Corp. Silver mineralization at Silver Dome is hosted in flat-lying Ordovician sandstones. The target at Silver Dome was bulk-minable gold mineralization amenable to open pit development. Columbus Silver completed 13 reverse-circulation holes totaling 1,640 m in a Phase I drilling program in late 2008. The Keg project is another silver property acquired by Cordex and Columbus Gold. This 405-ha property covers an area of stockwork quartz veining in a window of quartzite surrounded by Tertiary volcanic rocks and alluvium. Mapping, sampling, and a ground magnetic survey were completed. Maestro Ventures acquired the Kings Canyon sediment-hosted gold-silver property in southwestern Millard County in 2007 and the property was explored in the early 1990s, primarily by Crown Resources. The property contains several known gold zones, with the largest defined resource holding about 6.2 Mt averaging roughly 1 ppm gold. In 2008, Maestro completed 974 m of drilling in a 10-hole program to verify and expand the existing resources. The best hole (KC08-01) cut an interval of 30 m averaging 1.16 ppm gold. Preliminary bottle roll tests indicated gold recoveries of 86 to 91%. Copper King Mining Corporation initially acquired about 486 ha of mostly patented mining claims in the Drum (Detroit) mining district in 2007. Copper King later acquired an additional 445 ha of unpatented claims in the district through a merger with Western Utah Copper Company, giving Copper King a large land package, including some previously defined

small gold resources. Newmont Mining Corp. staked over 200 claims in the Stateline district of Iron County. Newmont completed 14 drill holes in the fall, focused on Miocene volcanic-rock-hosted, low-sulfidation, epithermal quartz-adularia-carbonate-pyrite \pm fluorite, gold-silver veins. Additional holes were planned for 2009. The following were other precious metal developments: (1) Grand Central Silver Mines, Inc. continued work on a 46-ha tract on the western fringe of the Bingham district in 2008, (2) Miranda Gold Corporation controlled about 130 claims on the Lookout Pass sedimentary-rock-hosted gold property in southeastern Tooele County, (3) Astral Mining Corp. controlled 23 claims in the Gold Springs district of Iron County, and (4) Almaden America Inc. located 50 claims in the Black Mountains of Iron County.

The rise in the price of uranium since 2001 caused an increase in exploration and development activity for uranium in Utah. Long-term uranium prices were about \$32 per kilogram (kg) of uranium; however, the spot price was currently lower, ranging from just \$18 to \$23/kg. Historically, Utah has been the third largest uranium-producing State, and the majority of its production is from the Colorado Plateau. Denison Mines Corp. owns the 1,800-t-per-day dual-circuit (uranium-vanadium) operation at the White Mesa Mill near Blanding. The mill switched from processing alternate feed waste material to uranium ore in April 2008. White Mesa Mill began operating on a 136,000-t ore stockpile from company-owned mines, but accepted ore from other companies for toll milling. Uranium recoveries were averaging over 90%. The mill was expected to produce about 1.36 million kg of uranium and 2 million kg of vanadium pentoxide annually by 2010. In late 2006, Denison's Pandora Mine, in the eastern La Sal district, was the first Utah property to resume uranium production. The Pandora Mine ships 136 t/d about 110 km south to the White Mesa Mill. Reserves at the Pandora Mine were estimated at 263,000 t at 0.22% uranium. Denison planned to reopen the Beaver Shaft mine, 3 km to the west of the Pandora Mine, in 2009. In 2008, production began at Denison's Rim Mine in the Dry Valley (East Canyon) district of San Juan County. The Rim Mine was operating at about 45 t/d with reserves estimated at about 136,000 t at 0.22% uranium and 2% vanadium pentoxide.

Denison's Henry Mountains Complex (Tony M Mine and Bullfrog properties) in the Shootaring Canyon district hosts the largest known uranium resource in Utah, estimated at about 2.1 Mt averaging 0.28% uranium, and an existing stockpile of 200,000 t of 0.138% uranium. The Tony M Mine was rehabilitated and mining resumed in late 2007 before declining uranium prices and lower than anticipated head grades forced its closure in late 2008. Energy Fuels, Inc. was also exploring and rehabilitating historical uranium mines. The Whirlwind Mine, on Beaver Mesa directly beneath the Utah-Colorado border about 45 km northeast of Moab, may begin producing in 2009. The Whirlwind resource is about 149,000 t of ore averaging 0.20% uranium and 0.66% vanadium pentoxide. Energy Fuels anticipated mining 45 to 180 t/d; however, the mine is currently on standby owing to low uranium prices. In 2007, Energy Fuels acquired the 284-ha Hecla Shaft mine, near La Sal, which was in rehabilitation. The mine, renamed Energy Queen, had an estimated resource of 161,000 t of ore averaging 0.22%

uranium and 0.86% vanadium pentoxide, with access via an existing 229-m-deep, lined shaft. Uranium One, Inc. acquired the uranium assets of the U.S. Energy Corp. in 2006 and Energy Metals in 2007. These assets include the Shootaring Canyon (Ticaboo) Uranium Mill in the Henry Mountains district. This 680-t/d mill is reportedly being repermited for operation. Another asset includes the Velvet Mine (210,000 t averaging 0.43% uranium) in the Lisbon Valley district that was permitted for mining.

Commodity Review

Industrial Minerals

Industrial minerals production, with an estimated value of \$1.05 billion, was the second-largest contributor to the value of minerals produced in 2008. This was the first year that industrial mineral values exceeded \$1 billion. The value of industrial minerals has grown substantially over the past 10 years, increasing from a low of \$500 million in 2000 to the high of \$1.05 billion in 2008, a 110% increase. Commodities that have realized the majority of these gains include sand and gravel, crushed stone, portland cement, lime, salt, magnesium chloride, and potash [potassium chloride and sulfate of potash (SOP)], and phosphate rock. These commodities accounted for about 90% of the total value of Utah's industrial minerals segment. Other commodities produced in Utah, in descending order of value, include gilsonite; bentonite, common clay, and kaolin; expanded shale; and gypsum. The overall value of industrial minerals increased because of increased production and substantial price increases for salt, magnesium compounds, potash, and phosphate rock, offset by reduced demands and value for construction-based materials such as sand and gravel, crushed stone, lime and quicklime, expanded shale, and gypsum.

Cement.—Portland cement (and lime) were the third-largest contributors to the value of industrial minerals produced in 2008. Two operators produce portland cement in Utah: Holcim, Inc. and Ash Grove Cement Company. Holcim's Devils Slide plant and mine are located east of Morgan in Morgan County, and Ash Grove's Leamington plant and mine are east of Lyndyl in Juab County. The companies have a combined listed capacity of about 1.5 Mt of cement annually. Both plants operated below listed capacity in 2008, essentially the same as in 2007. In addition to limestone, Ash Grove Cement quarried a modest amount of shale and sandstone that are used in the manufacture of cement.

Clays.—Five companies produced approximately 263,000 t of common clay, bentonite, and high-alumina clay in 2008. Statewide, there were 21 active mine permits held by common clay, bentonite, and high-alumina clay operators in 2008. Many of these mines operated intermittently. The two largest producers of common clay in 2008 were Western Clay Company (bentonite) and Interstate Brick Company (common clay). In addition, Interpace Industries (common clay), Redmond Minerals, Inc. (bentonite), and Sandy Nell (high-alumina clay) produced lesser amounts. More than 75% of all common clay was used in the manufacture of brick. Bentonite is used as a sealant in many civil engineering applications, as a pet-waste

absorbent (litter-box filler), as a component of oil and gas drilling fluids, and as a binder in foundry molds. High-alumina clays are currently only being used in the manufacture of portland cement.

Gilsonite.—Gilsonite production for 2008 was estimated to be about 68,000 t, a decrease of about 8,100 t from 2007. Gilsonite is an unusual solid hydrocarbon that has been mined in Utah for more than 100 years. Gilsonite was marketed worldwide for use in more than 150 products ranging from printing inks to explosives. All of the gilsonite mines are located in southeastern Uintah County. The three companies that produce gilsonite, in descending order of production, are American Gilsonite Company, Lexco, Inc., and Zeigler Chemical and Minerals Company. Although lower in 2008, gilsonite production has been increasing modestly during the past several years.

Gypsum.—Seven operators produced 270,000 t of gypsum in 2008, about 99,000 t (26%) less than in 2007. In descending order of production, the three largest producers were U.S. Gypsum Company, Sunroc Corporation (Clyde Companies), and Georgia Pacific Gypsum. Georgia Pacific Gypsum and U.S. Gypsum operated the only two wallboard plants in Utah. Both plants are near Sigurd in Sevier County. The Georgia Pacific plant, which reopened in 2006 after being closed since 2002, shut down again in early 2008. Most gypsum produced in Utah was used for making wallboard, but several operators supplied raw gypsum to regional cement companies, where it was used as an additive to retard the setting time of cement, and to the agricultural industry for use as a soil conditioner. The decreased production of gypsum was likely related to the downturn of the housing industry.

Lime.—Lime production was about 16% lower in 2008 than in 2007, with an estimated production of about 713,000 t. There were two suppliers of lime in Utah, with a combined capacity of more than 900,000 t/y: Graymont Western U.S., Inc., which produced dolomitic quicklime and high-calcium quicklime; and Chemical Lime of Arizona, Inc., which produces dolomitic quicklime and hydrated dolomitic lime. Both operations serve markets in Utah and surrounding States. Graymont Western's plant is in the Cricket Mountains, approximately 56 km southwest of Delta in Millard County, and is one of the 10 largest lime plants in the United States. The addition of a fifth kiln to Graymont's Cricket Mountain plant added about 500,000 t/y of capacity. Chemical Lime of Arizona's plant, located about 13 km northwest of Grantsville in Tooele County, closed in mid-2008 because of the economic recession. Statewide, the DOGM has 40 active limestone operations including 18 large mine and 22 small mine permits. Total limestone production reported in 2008 was 4.7 Mt. Other uses of limestone included construction as well as flue-gas desulfurization in coal-fired powerplants. A small amount of limestone is also crushed to a fine powder and marketed as "rock dust" to the coal mining industry.

Magnesium Chloride, Potash (potassium chloride and sulfate of potash), and Salt.—Brine-derived products, including salt, were the largest contributors to the value of industrial mineral production in Utah in 2008, with a combined value of \$376 million, about \$129 million (52%) more than in 2007. In addition to salt, brine-derived products included magnesium

chloride and potash (potassium chloride and potassium sulfate). One company (North Shore Limited Partnership) produced a small amount of concentrated magnesium brine that was used as an ingredient in mineral food supplements. The statewide production of salt and other brine-derived products, excluding magnesium metal, was estimated to be 3.65 Mt in 2008, about 0.4 Mt more than in 2007. Potash production (including SOP) was estimated to be about 0.39 Mt in 2008. Salt production alone was estimated to be 2.8 Mt in 2008, about 0.32 Mt more than in 2007, with most of the production coming from three operators processing brine from the Great Salt Lake. The three operators are, in descending order of production: Great Salt Lake Minerals Corporation, Cargill Salt Company, and Morton International. In addition, three other companies produce salt and/or potash from operations not located on Great Salt Lake: Intrepid Potash-Wendover, LLC near Wendover in Tooele County (salt and potash), Intrepid Potash-Moab, LLC near Moab in Grand County (salt and potash), and Redmond Minerals, Inc. near Redmond in Sanpete County (rock salt). Redmond Minerals has significantly increased production during the past 5 years because of an aggressive marketing campaign.

Phosphate Rock.—Simplot Phosphates, LLC was Utah's only phosphate producer. The company's phosphate operation is 18 km north of Vernal in Uintah County. The mine produced roughly 2.7 to 3.6 Mt of ore, which was processed into more than 1 Mt of phosphate concentrate. The concentrate is transported in slurry form to the company's Rock Springs, Wyoming, fertilizer plant via a 144-km underground pipeline. During 2008, Rock Springs processed about 3.4 Mt of ore, slightly more than in 2007.

Sand and Gravel, Construction, and Stone, Crushed.—Sand and gravel, and crushed stone (including limestone and dolomite), were the second-largest contributors to the value of industrial minerals produced in Utah during 2008, with an estimated value of \$240 million, about \$77.8 million (24%) lower than in 2007. These materials were produced in nearly every county in Utah by commercial operators as well as county, State, and Federal agencies. Owing to the large number of operations (approximately 140 active pits and quarries), the UGS does not send production questionnaires to this group. Production of sand and gravel and crushed stone decreased in 2008 (table 1). These decreases are mostly due to the decline in regional and local residential, commercial, and infrastructure construction.

Shale, Expanded.— Only one company, Utelite, Inc. produced lightweight "expanded" products from shale for use primarily in the construction and building industries. Mine production was about 203,000 Mt in 2008, an increase of 22,500 Mt from that in 2007. Utelite's shale plant and mine is east of the town of Wanship in Summit County.

Metals

The value of base and precious metals totaled \$3.29 billion in 2008, an increase of \$141 million (4%) compared to 2007. Base-metal production, with an estimated value of \$2.90 billion, was the largest contributor to the value of minerals produced in 2008. In descending order of value, those metals were copper,

molybdenum, magnesium, vanadium, iron, and beryllium. The 2008 base-metal value was about \$73.3 million (3%) higher than in 2007. Precious-metal production, valued at \$390 million, included gold (86% of total value) and silver (14% of total value). Precious-metal values in 2008 were \$68 million (21%) higher than in 2007, and near the record high of \$400 million established in 2006.

Kennecott Utah Copper Corporation's (KUC) Bingham Canyon mine, located about 32 km southwest of Salt Lake City in Salt Lake County, is the State's major producer of copper, gold, and silver, and its sole producer of molybdenum. Kennecott is the second-largest copper producer in the United States based on 2008 production. Kennecott supplied approximately 12% of U.S. annual refined copper requirements. The combined value of minerals produced from the Bingham Canyon Mine in 2008 was about 61% of the total value of all minerals produced statewide.

Beryllium.—Utah continued to be the Nation's sole producer of beryllium concentrates. Brush Resources Inc. operated a beryllium (bertrandite) mine in Juab County. Brush imported ore and beryl and processed both through parallel circuits at the company's plant a few miles north of Delta in Millard County. The product (beryllium hydroxide) was sent to the company-owned refinery and finishing plant in Elmore, OH, where it was converted into beryllium metal, alloys, and oxide. Brush's Monitor pit closed in 2008, and production began at the new Fluro-Roadside pit. In 2005, Brush Engineered Materials, Inc. (the parent company) was awarded a \$9 million contract under the Department of Defense's Defense Production Act, Title III Program. The contract was for the engineering and design of a new facility to produce primary beryllium, the feedstock material used to produce beryllium metal products. Construction of the new facility, to be owned and operated by Brush Engineered Materials, began in 2008 and was expected to take 3 years to complete (Jaskula, 2009). The new facility is located at an existing plant site in Elmore.

Copper and Molybdenum.—Copper was the largest contributor to the value of nonfuel minerals in Utah. Substantial price increases, which began in 2003, raised the value of copper produced to a near alltime high, and the value of base-metal production statewide to nearly \$3 billion. The Bingham Canyon Mine produced about 238,000 t of copper in 2008, compared to the 212,000 t produced in 2007. Rio Tinto (KUC's parent company) also reported that refinery production was 201,000 t compared to 266,000 t in 2007 (Rio Tinto, 2009). Kennecott is in the fifth year of an aggressive mine life extension program. The Lisbon Valley Copper mine, located 72 km southeast of Moab in San Juan County, began operating in December 2005, but because of lower than anticipated recovery grades and excessive processing costs, the mine went to a leach-only system in 2008. Mining was curtailed but leaching was expected to continue until the ore pad had been depleted. Molybdenum was the second-largest contributor to the value of Utah's base-metal production in 2008. Kennecott's Bingham Canyon Mine produced about 10,600 t of byproduct molybdenum in 2008, compared to 14,900 t produced in 2007. Rio Tinto reported that the lower molybdenum production was because of a 17% decrease in ore grades compared to 2007.

Gold and Silver.—Gold production in 2008 was estimated to be about 11,600 kg (373,000 troy ounces), about 930 kg (30,000 troy ounces) less than in 2007. Gold was produced from two surface mines owned by Kennecott Corporation: one primary producer (Barneys Canyon Mine) and one byproduct operation (Bingham Canyon Mine), both in Salt Lake County. Several other small mines in the State were expected to produce minor amounts of gold and silver, but production was not reported or included in the above totals. The Barneys Canyon Mine exhausted its economic ore reserves in late 2001 and ceased mining, but was expected to continue to produce gold from its heap-leach pads at a much-reduced rate into 2009, when those pads were expected to be depleted. Silver was also a byproduct metal from the Bingham Canyon Mine. Silver production was about 106,000 kg (3.4 million troy ounces) in 2008, slightly less than that of 2007.

Iron Ore.—Iron Bull Mining and Milling Company, a subsidiary of Palladon Ventures, Ltd., began producing ore at the historic Comstock-Mountain Lion open pit mine, near Cedar City, in September 2008. Direct shipments to China were scheduled to begin immediately, but were delayed because of unavailable storage space at the selected west coast port. A small amount of ore was mined and placed on the existing stockpile. Numerous infrastructure improvements to the mine, loadout, and railroad siding were made in 2008.

Magnesium.—Magnesium metal was the third-largest contributor to the value of base metals in 2008. Magnesium metal was produced from Great Salt Lake brines by U.S. Magnesium at its electrolytic plant at Rowley in Tooele County. The plant's annual capacity is 43,000 t of magnesium metal (99.8% purity). The Rowley plant was the only active primary magnesium processing facility in the United States. Magnesium production in 2008 was moderately higher than in 2007. Average magnesium metal prices increased from \$3.09/kg in 2006, to \$4.84/kg in 2007, and to \$7.70/kg in 2008 (Kramer, 2009).

Vanadium.—Vanadium was produced as a byproduct with uranium in some, but not all, uranium mines in Utah, and was recovered in the form of vanadium pentoxide during the milling of uranium ore. Two mines operated by Denison Mines produced an undisclosed amount of vanadium-bearing ore in 2008. Vanadium pentoxide prices more than doubled in 2008, ranging from \$7.30 to \$18.40 per pound of vanadium pentoxide, and averaged \$14.75 per pound of vanadium pentoxide for the year. The sharp rise in prices in 2008 was mostly owing to reduced vanadium production in China and South Africa (Magyar, 2009b).

Mineral Fuels and Related Materials

Uranium.—Denison Mines produced uranium and uranium/vanadium ore from three mines and produced uranium oxide and vanadium pentoxide from the White Mesa Mill, which is located in San Juan County. According to Denison, the mill was the only conventional uranium mill operating in the United States. White Mesa is strategically located within hauling distance of all of Denison's current U.S. mine and exploration

properties on the Colorado Plateau, the Henry Mountains area, and the Arizona Strip. Mill production for 2008 was expected to yield 0.45 million kg of uranium oxide and 0.68 million to 0.91 million kg of vanadium pentoxide (Denison Mines, 2009).

Environmental Issues and Other Activities

The U.S. Department of Energy and the State of Utah agreed in 2005 to move the 10.8 Mt of uranium mill tailings (Atlas Mill) located along the Colorado River near Moab. The tailings were estimated to average about 100 ppm uranium and 400 ppm vanadium. The tailings were expected to be moved 48 km north to a site near Crescent Junction. The Department of Energy transported the tailings by rail to the 100-ha disposal cell recently approved by the Nuclear Regulatory Commission. The reclamation project has an anticipated completion date of 2019. Reclamation at the 81-ha Midvale Superfund slag site (Bingham Consolidated Smelter) is complete, and the site along the Jordan River was undergoing mixed-use development at Bingham Junction. Scheduled development includes 48 ha of houses, apartments, and retail and office space with an additional 4.5 ha of wetlands. Kennecott Utah Copper's South Zone in southwestern Salt Lake County has been removed from the Environmental Protection Agency list of potential Superfund sites. Kennecott spent more than \$400 million on clean-up efforts in this area.

The following publications provide new information on the mineral resources of Utah and have been made available through the Utah Department of Natural Resources Map and Bookstore at <http://mapstore.utah.gov/>. Additional geographic information system (GIS) data on Utah is available for free download at <http://agrc.its.state.ut.us/> and <http://geology.utah.gov/databases/index.htm>. "Hydrocarbon Systems and Production in the Uinta Basin, Utah" is a new CD published as Rocky Mountain Association of Geologists and Utah Geological Association Publication 37, edited by Mark W. Longman and Craig D. Morgan. The volume contains a series of papers on the stratigraphy, oil and gas fields, and related papers on the Uinta Basin of northeastern Utah. The CD includes papers on the (1) "Distribution, Amount, and Maturity of Coal Resources of most of the Sego Coalfield, Utah" by David E. Tabet and others, (2) "Gilsonite Resources of the Uinta Basin, Utah" by Taylor Boden and Bryce T. Tripp, and (3) "Sediment-Hosted Polymetallic Mineralization in the Uinta Basin, Duchesne and Uintah Counties, Utah" by G. R. Conn and Ken Krahulec.

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TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN UTAH^{1,2}

(Thousand metric tons and thousand dollars unless otherwise specified)

Mineral	2006		2007		2008		
	Quantity	Value	Quantity	Value	Quantity	Value	
Beryllium concentrates	metric tons	3,830	NA	3,810	NA	4,410	NA
Clays, Common		526	10,700	531	10,400	479	10,200
Gemstones, natural		NA	238	NA	240	NA	781
Salt		2,350	149,000	2,470	135,000	2,150	139,000
Sand and gravel, construction		42,400	204,000	45,100	261,000	37,400	214,000
Stone:							
Crushed		14,000	89,100	13,200 ^r	97,800 ^r	8,920	71,600
Dimension		8	585	8	619	9	707
Combined values of cement (portland), clays (bentonite), copper, gold, gypsum (crude), helium (Grade-A), lime, magnesium compounds, magnesium metal, molybdenum concentrates, perlite [crude (2006)], phosphate rock, potash, silver		XX	3,560,000	XX	3,370,000	XX	3,730,000
Total		XX	4,010,000	XX	3,880,000	XX	4,160,000

^rRevised. NA Not available. XX Not applicable.

¹Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

²Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 2
UTAH: CRUSHED STONE SOLD OR USED, BY TYPE¹

Type	2007			2008		
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Number of quarries	Quantity (thousand metric tons)	Value (thousands)
Limestone	12 ^r	5,580 ^r	\$40,300 ^r	13	5,290	\$43,100
Dolomite	2	769	5,940	2	1,800	14,100
Traprock	3	21	128	--	--	--
Sandstone and quartzite	-- ^r	-- ^r	-- ^r	--	--	--
Volcanic cinder and scoria	3	24	467	2	10	274
Miscellaneous stone	20 ^r	6,800 ^r	50,900 ^r	13	1,810	14,100
Total	XX	13,200 ^r	97,800 ^r	XX	8,920	71,600

^rRevised. XX Not applicable. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 3
UTAH: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2008, BY USE¹

(Thousand metric tons and thousand dollars)

Use	Quantity	Value
Construction:		
Coarse aggregate (+1½ inch):		
Macadam	W	W
Riprap and jetty stone	371	4,460
Other coarse aggregate	569	3,420
Coarse aggregate, graded, other	859	7,060
Fine aggregate (-¾ inch), other	856	6,530
Coarse and fine aggregates:		
Terrazzo and exposed aggregate	W	W
Other coarse and fine aggregates	271	1,620
Agricultural, poultry grit and mineral food	W	W
Chemical and metallurgical:		
Cement manufacture	2,510	19,500
Dead-burned dolomite manufacture	W	W
Flux stone	W	W
Special, mine dusting or acid water treatment	W	W
Other miscellaneous uses and specified uses not listed	12	429
Unspecified: ²		
Reported	99	571
Estimated	3,200	25,000
Total	8,920	71,600

W Withheld to avoid disclosing company proprietary data, except unit value; included in "Total."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Reported and estimated production without a breakdown by end use.

TABLE 4
UTAH: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2008, BY USE AND DISTRICT¹

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction:								
Coarse aggregate (+1½ inch) ²	W	W	W	W	6	46	--	--
Coarse aggregate, graded ³	W	W	W	W	--	--	--	--
Fine aggregate (-¾ inch) ⁴	W	W	W	W	--	--	--	--
Coarse and fine aggregate ⁵	W	W	W	W	--	--	--	--
Agricultural ⁶	--	--	W	W	--	--	--	--
Chemical and metallurgical ⁷	W	W	W	W	--	--	--	--
Special ⁸	--	--	W	W	--	--	--	--
Other miscellaneous uses	12	429	--	--	--	--	--	--
Unspecified: ⁹								
Reported	--	--	55	431	7	48	38	92
Estimated	2,900	23,000	159	1,200	132	1,000	--	--
Total	5,010	38,700	3,720	31,700	145	1,130	38	92

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes macadam, riprap and jetty stone, and other coarse aggregate.

³Includes other graded coarse aggregate.

⁴Includes other fine aggregate.

⁵Includes terrazzo and exposed aggregate and other coarse and fine aggregates.

⁶Includes poultry grit and mineral food.

⁷Includes cement manufacture, dead-burned dolomite manufacture, and flux stone.

⁸Includes mine dusting or acid water treatment.

⁹Reported and estimated production without a breakdown by end use.

TABLE 5
UTAH: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2008,
BY MAJOR USE CATEGORY¹

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand) ²	2,370	\$22,800	\$9.62
Asphaltic concrete aggregates and other bituminous mixtures	1,060	7,060	6.63
Road base and coverings ³	6,940	40,000	5.77
Fill	5,670	23,400	4.12
Other miscellaneous uses ⁴	151	1,200	7.97
Unspecified: ⁵			
Reported	7,750	44,200	5.70
Estimated	13,500	75,500	5.60
Total or average	37,400	214,000	5.72

¹Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

²Includes plaster and gunite sands.

³Includes road and other stabilization (cement).

⁴Includes snow and ice control and railroad ballast.

⁵Reported and estimated production without a breakdown by end use.

TABLE 6
UTAH: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2008, BY USE AND DISTRICT¹

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (including concrete sand) ²	W	W	1,670	16,500	W	W
Asphaltic concrete aggregates and road base materials ³	1270	8520	4,200	25,600	2,140	11,600
Fill	715	2,660	4,320	18,000	589	2,630
Other miscellaneous uses ⁴	419	3,570	80	579	332	3,330
Unspecified: ⁵						
Reported	1,860	10,600	4,510	27,700	831	4,780
Estimated	4,160	23,400	5,360	29,500	3,830	21,800
Total	8,420	48,800	20,100	118,000	7,720	44,100
	Unspecified districts					
	Quantity	Value				
Concrete aggregate (including concrete sand) ²	22	88				
Asphaltic concrete aggregates and road base materials ³	394	1,420				
Fill	54	89				
Other miscellaneous uses ⁴	--	--				
Unspecified: ⁵						
Reported	549	1,120				
Estimated	137	769				
Total	1,160	3,480				

W Withheld to avoid disclosing company proprietary data; included in "Other miscellaneous uses." -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes plaster and gunite sands.

³Includes road and other stabilization (cement).

⁴Includes snow and ice control and railroad ballast.

⁵Reported and estimated production without a breakdown by end use.