2009 SUMMARY OF MINERAL ACTIVITY IN UTAH

by Roger L. Bon and Ken Krahulec

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UTAH GEOLOGICAL SURVEY
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Utah Department of Natural Resources
2010

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Cover photos: *View of the Bingham Canyon open pit copper-gold-molybdenum mine, Salt Lake County, Utah. This photograph looks northeast over the pit, down Bingham Canyon, toward Salt Lake City.*

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2009 SUMMARY OF MINERAL ACTIVITY IN UTAH

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ABSTRACT

Utah mines and energy companies produced a gross value of $6.97 billion in energy and mineral commodities in 2009. On an inflation-adjusted basis, this is $2.43 billion (26%) less than the record high of $9.39 billion reached in 2008. Mineral production (excluding oil and gas) totaled $4.38 billion, including base-metals production of $2.13 billion, industrial-minerals production of $0.96 billion, energy-minerals production of $0.66 billion, and precious-metals production of $0.64 billion. Preliminary estimates from the U.S. Geological Survey rank Utah 3rd nationally in the value of nonfuel minerals produced in 2009, and Utah accounted for about 7% of the total U.S. nonfuel minerals production value. Utah remained the only state that produced beryllium concentrates, magnesium metal, or gilsonite. Mineral exploration decreased in 2009 with only 18 Notices of Intent to Explore being filed with the State compared to 64 in 2008. Approximately 1400 (down from 6000 in 2008) new federal unpatented mining claims were recorded by the U.S. Bureau of Land Management. New mine developments include the permitting of one surface coal mine and the opening of one new uranium mine. During 2009, the Utah Division of Oil, Gas, and Mining listed 114 active Large mines (including coal mines) and 195 active Small mines.

INTRODUCTION

Background

The Utah Geological Survey (UGS) has compiled mineral activity summaries for Utah on an annual basis beginning in 1989. These summaries, ending in 2008, have been published in the May issues of *Mining Engineering*, a publication of the Society for Mining, Metallurgy, and Exploration, Inc. The Utah mineral activity summaries from 1996 through 2009 are available on the UGS Web site at http://geology.utah.gov/utahgeo/rockmineral/index.htm#minactivity.

The summaries (1993–2009) divide mineral values into four broad segments of Utah's mineral industry, including base metals, precious metals, industrial minerals, and energy minerals (coal and uranium). In addition to acquiring data through operator surveys, the UGS works in cooperation with the U.S. Geological Survey (USGS) and Utah Division of Oil, Gas, and Mining. A large part of the data for exploration and development activity is acquired from company Web sites, trade industry publications, and correspondence.

Historical Context

The importance of Utah's mineral industry to the state and nation cannot be overemphasized. The production of salt from Great Salt Lake and the manufacture of clay and lime products were some of the first commercial ventures established upon arrival of the pioneers in 1847. Following the completion of the transcontinental railroad in 1869, metal mining and smelting proliferated as goods and services became more accessible. By the early 1900s, Utah was firmly established as one of the largest mining and smelting centers in the western U.S.

Mineral values grew exponentially as the mining industry expanded. USGS data show that mineral production (mostly metals) increased from about $56,000 in 1865 to nearly $10 million by 1895, $20 million by 1904, and nearly $100 million by 1917 (Butler and others, 1920). Data acquired from the U.S. Bureau of Mines (USBM) and published in the Utah Historical Quarterly (Romney, 1963) show that the total value of all minerals produced in Utah and sold commercially grew from $28 million in 1905 to more than $430 million by 1960. Data compiled by the Utah Geological Survey (UGS) from the USBM, USGS, and other data sources show that the nominal value of minerals produced in Utah, including metals, nonmetals, mineral fuels, and hydrocarbons, has increased from $426 million in 1960 to a record high of $9.54 billion in 2008. The value for 2009 ($6.97 billion) reflects the effects of the severe nationwide economic downturn that began in the spring of 2008 and effected nearly every facet of Utah's industrial base, including mining.

Although the relative importance of the mining industry compared to the value of all goods and services statewide (expressed as a percent of state Gross Domestic Product) has diminished as the state has grown and the industry has matured (7.4% in 1981 [Utah Office of Planning and Budget, 1992, table 18] vs. 1.7% in 2008 (Governor's Office of Planning and Budget, 2010, table 37), the mining industry will continue to be an important contributor to the state's economy well into the 21st century.

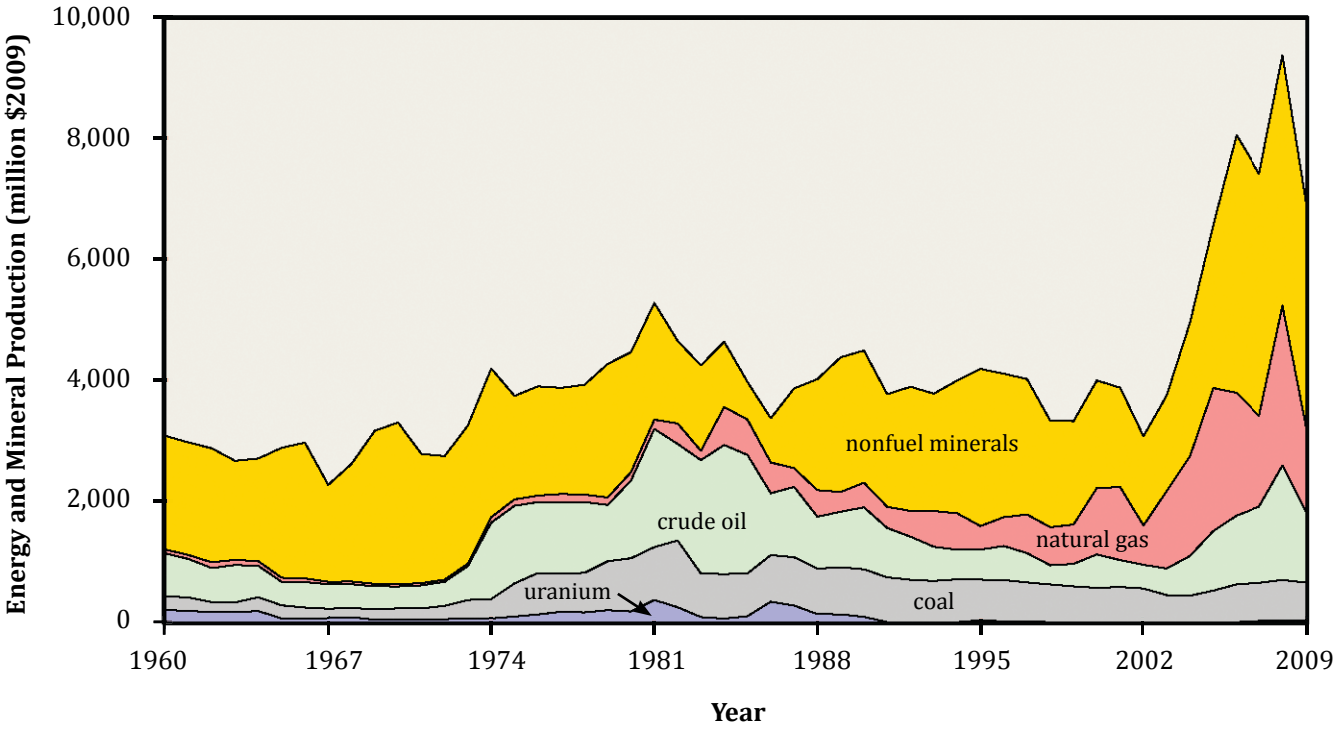

Figure 1. *Total annual value of Utah's energy and mineral production 1960–2009, inflation adjusted to 2009 dollars.*

Industry Overview

The gross value (in inflation-adjusted dollars) of all energy and mineral commodities produced in Utah in 2009 is $6.97 billion, $2.43 billion (26%) less than the revised record high of $9.39 billion reached in 2008 (figure 1). The drop in the 2009 value is due to decreases in nonfuel mineral, crude oil, and natural gas values. Despite lower overall nonfuel mineral values, the value of gold reached a record high due to increased production and near record-high prices.

The value of Utah's mineral production (excluding oil and natural gas) in 2009 is estimated to be $4.38 billion (figure 2; table 1), $0.67 billion (13%) lower than the revised value of $5.05 billion for 2008. With the exception of precious metals, all segments of Utah's mineral industry showed a decrease in values compared to 2008. Contributions from each of the mineral segments were as follows: base metals, $2.13 billion (49% of total); industrial minerals, $0.96 billion (22% of total); energy minerals, $0.66 billion (15% of total); and precious metals, $0.64 billion (14% of total) (figure 2; table 1). Compared to 2008, the 2009 values of (1) base metals decreased $767 million (26%), (2) industrial minerals decreased $98.8 million (9%), (3) energy minerals decreased $45.5 million (6%), and (4) precious metals increased $245 million (63%).

Preliminary estimates from the USGS rank Utah 3rd nationally in the value of nonfuel minerals produced in 2009, and Utah accounted for about 7% of the total U.S. nonfuel mineral production value (USGS, 2010). Based on annual production tonnages provided by the Energy Information Administration, Utah ranked 14th in coal production in 2008 (Energy Information Administration, 2009) and will likely retain the same ranking for 2009.

After a five-year run-up, commodity prices in general peaked in mid-2008, collapsed late that year, then gradually rebounded throughout 2009. Base-metal exploration in 2009 was dominated by major companies doing brownfield exploration in the Bingham and Tintic mining districts. Despite strong precious-metals prices, exploration activity in 2009 for Au and Ag has waned, largely due to the inability of small exploration companies to raise funds. Uranium oxide prices spiked to a high of $300/kg ($136/lb) in June 2007; however, the price fell to under $100/kg ($45/lb) at the end of 2009. Uranium exploration and development activity has tracked these spot prices.

During 2009, the Utah Division of Oil, Gas and Mining (DOGM) received four new Large Mine permit applications (2 ha [5 acres] and larger disturbance) and 15 new Small Mine permit applications (less than 2 ha [5 acres] disturbance). Eighteen Notices of Intent to explore on public lands were filed with DOGM in 2009, compared to 64 in 2008 and 53 in 2007. Slightly more than 1400 (down from 6000 in 2008) new federal unpatented mining claims were recorded by the BLM, and the Utah School and Institutional Trust Lands Administration reported signing mineral lease contracts on 61 tracts of land in 2009 compared to 196 tracts in 2008.

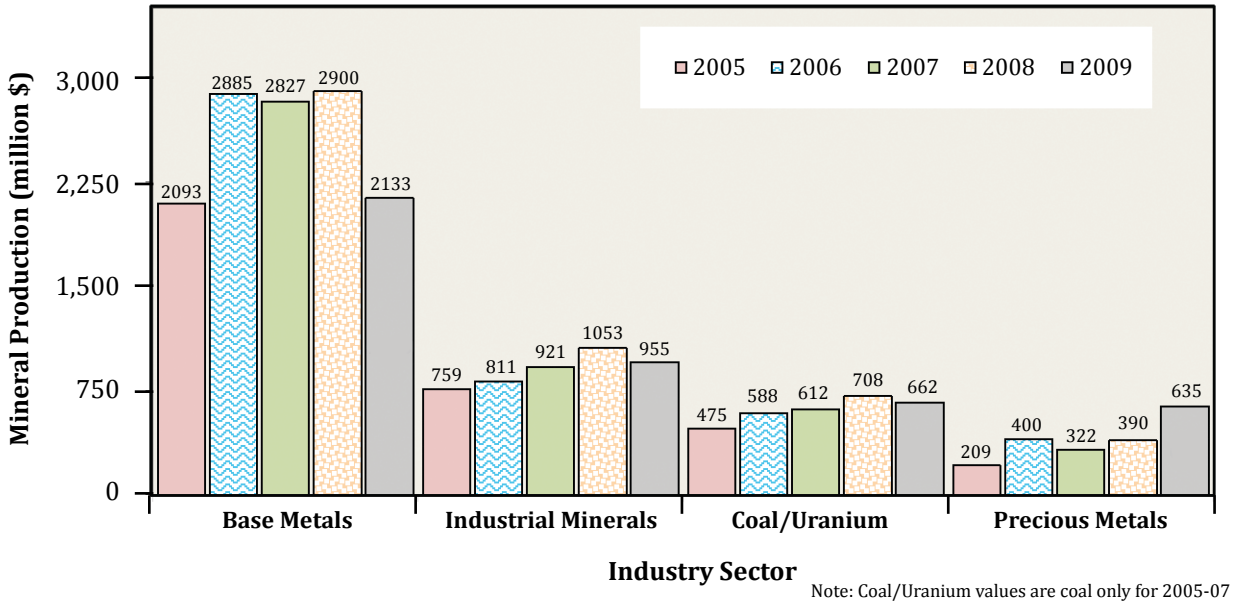

Figure 2. *Value of Utah's annual mineral production in nominal dollars, by industry sector, from 2005 through 2009.*

Table 1. *Utah estimated mineral production values in nominal dollars by industry segment from 2000 through 2009; value is in millions.*

Year	Base Metals	Industrial Minerals	Energy Minerals	Precious Metals	Total Value
2000	$749	$500	$456	$212	$1916
2001	$693	$538	$480	$240	$1951
2002	$612	$565	$467	$172	$1815
2003	$690	$555	$384	$136	$1765
2004	$1136	$643	$386	$158	$2324
2005	$2093	$759	$475	$209	$3536
2006	$2885	$811	$588	$400	$4684
2007	$2827	$921	*$612	$322	*$4682
2008	$2900	$1053	$708	$390	$5051
2009	$2133	$955	$622	$635	$4385

Note: Totals may not equal the sum of individual parts due to rounding.
*revised data.

The outlook for 2010 is for a moderate increase in the value of nonfuel mineral production based largely on projections for higher base-metal production and higher metal prices. Overall, the value for industrial minerals will decrease because of lower potash and other brine-product prices and a continued decline of Utah's construction industry. The value of coal will likely decline as indicated by lower production estimates provided by several operators. One new coal mine is in development and plans to begin initial production in 2011. One surface coal mine received its permit in 2009, although no development plans have been announced. The boom in uranium exploration and the reopening of several mines and a second uranium mill has been tempered by continued low uranium prices. However, one new uranium mine commenced production in late 2009, which will add a moderate amount to energy values in 2010. The start-up of a titanium sponge plant adjacent to U.S. Magnesium's magnesium facility on the west shore of Great Salt Lake will add incremental demand for magnesium and begin a new era in metal processing in the state. Utah's lone iron mine remains idle and no announcement has been made as to when operations might resume. One new copper mine began production in 2009, but experienced problems with its mill that resulted in only a small amount of concentrates being produced.

NATIONAL RANKINGS

The USGS's 2009 preliminary data ranks Utah 3rd in the nation in the value of nonfuel mineral production, up from 4th in 2008. USGS data show that Utah remained the only state that produced beryllium concentrates and magnesium metal. Additionally, Utah continued to be 2nd in the quantity of copper, potash, and magnesium compounds produced (in descending order of value); 3rd in molybdenum concentrates, gold, and bentonite clay; 4th in phosphate rock, gemstones, and silver; and 6th in salt. The state was also a significant producer of Portland cement, construction sand and gravel, lime, and common clays (Arnold Tanner, USGS, verbal communication, March 2010).

The USGS's preliminary estimate of the value of Utah's nonfuel mineral production for 2009 is $4.00 billion

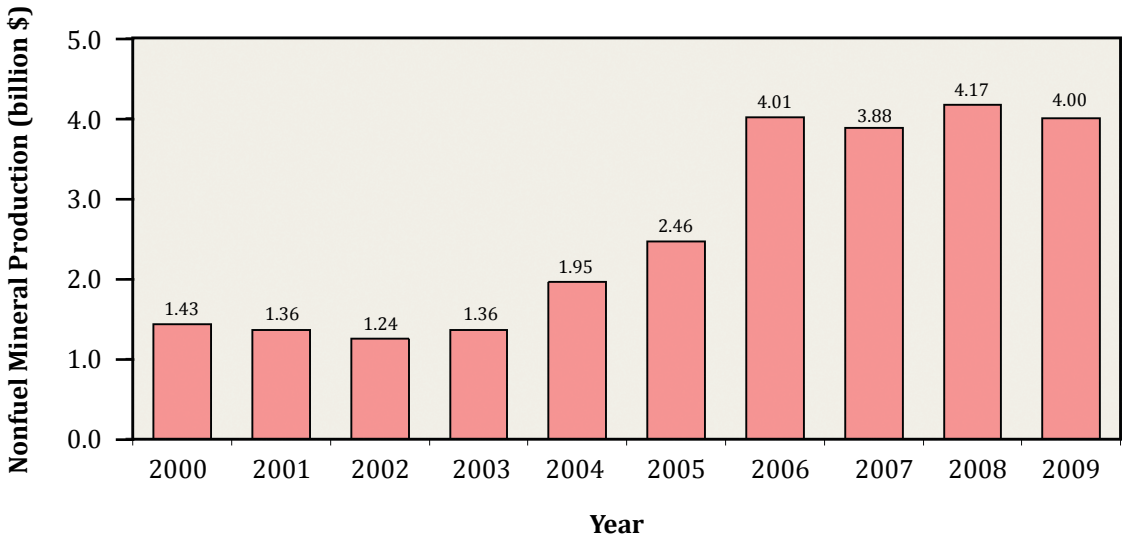

Figure 3. *Total annual value of Utah's nonfuel mineral production in nominal dollars, from 2000 through 2009. Source: U.S. Geological Survey.*

(USGS, 2010), about $0.17 billion (4%) lower than in 2008. USGS data show that over the past 10 years (2001 through 2009) the value of nonfuel mineral production in Utah ranged from a low of $1.24 billion (2002) to a high of $4.17 billion in 2008 (figure 3). The Utah Geological Survey's (UGS) estimate for the value of nonfuel mineral production for 2009 is $3.72 billion (see table 1), a decrease of $0.62 billion (14%) compared to a revised $4.34 billion for 2008.

BASE- AND PRECIOUS-METAL PRODUCTION

The value of base and precious metals totaled $2.77 billion in 2009, a decrease of $0.52 billion (16%) compared to 2008. Base-metal production, with an estimated value of $2.13 billion, was the largest contributor to the value of minerals produced in 2009 (figure 2; table 1). In descending order of value, those metals were copper, molybdenum, magnesium, vanadium, and beryllium. The 2009 base-metal value was about $0.77 billion (26%) lower than 2008, which was a benchmark year for metal values. Precious-metal production, valued at $635 million (figure 2; table 1), includes gold (86% of total value) and silver (14% of total value). Precious-metal values in 2009 were $245 million (63%) higher than in 2008 and set a new record for precious-metal values. The previous record of $400 million was set in 2006.

Kennecott Utah Copper Corporation's (KUC) Bingham Canyon mine, located about 32 km (20 mi) 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. The USGS reports that the Bingham Canyon mine was the largest copper producer in the U.S. (25% of total U.S. mine production) in 2009 (Daniel Edelstein, USGS, written communication, April 2010). The combined value of minerals produced from the Bingham Canyon mine in 2009 was about 59% of the total value of all minerals produced statewide.

Copper

Copper was the largest contributor to the value of nonfuel minerals in Utah with an estimated value of $1.7 billion. Substantial price increases, which began in 2003, raised the value of copper produced to a near all-time high, and the value of base-metal production statewide to $2.13 billion. The Bingham Canyon mine produced about 307,000 mt (339,000 st) of copper in 2009, compared to the 238,000 mt (262,000 st) produced in 2008.

The Lisbon Valley Copper mine, located 72 km (45 mi) southeast of Moab in San Juan County, began operating in December 2005, and due to lower-than-anticipated recovery grades and excessive processing costs, the mine went to a leach-only system in 2008. Mining resumed in August 2009, and 2010 production is projected to be about 4500 mt (5000 st) with a 14-year mine life (Bob Frayser, Lisbon Valley Mining Company, written communication, March 2010).

Molybdenum

Molybdenum was the second-largest contributor to the value of Utah's base-metal production in 2009. Kennecott's Bingham Canyon mine produced about 11,200 mt (12,400 st) of by-product molybdenum in 2009, compared to 10,600 mt (11,700 st) produced in 2008. The USGS reports that the Bingham Canyon mine was one of seven domestic copper mines to recover molybdenum as a by-product. The USGS also reports that the total U.S. mine output of molybdenum in concentrate decreased about 11% from 2008 (USGS, 2010).

Magnesium

Magnesium metal was the third-largest contributor to the value of base metals in 2009. Magnesium metal is produced from Great Salt Lake brines by US Magnesium, LLC at its electrolytic plant at Rowley in Tooele County. The plant's annual capacity is 43,000 mt (47,000 st) of magnesium metal (99.8% purity). It is the only active primary magnesium processing facility in the U.S. Magnesium production in 2009 was moderately higher than in 2008. Average magnesium metal prices decreased from $6.95/kg ($3.15/lb) in 2008, to $5.29/kg ($2.40/lb) in 2009 (USGS, 2010).

Vanadium

Vanadium is produced as a co-product with uranium in several uranium mines in Utah and is recovered in the form of vanadium pentoxide (V_2O_5) during the milling of uranium ore. Three mines operated by Denison Mines, Inc. produced about 106,000 mt (117,000 st) of vanadium-bearing ore in 2009. Vanadium pentoxide prices, which more than doubled in 2008 and averaged $32.56/kg ($14.75/lb) for the year, plummeted to an average of $13.25/kg ($6.00/lb) in 2009. The sharp decrease in prices in 2009 was mostly due to reduced vanadium demand for use as an alloy in steel production (USGS, 2010). See section on Uranium for more information on the mines.

Beryllium

Utah continues to be the nation's sole producer of beryllium concentrates. Brush Resources operates a beryllium (bertrandite) mine in Juab County, and ore and imported beryl can both be processed through parallel circuits at the company's plant a few miles north of Delta in Millard County. The product (beryllium hydroxide) is then sent to the company-owned refinery and finishing plant in Elmore, Ohio, where it is converted into beryllium metal, alloys, and oxide. The USGS reported that approximately 109 mt (120 st) of beryllium in an undisclosed amount of produced ore, imported beryl, and beryl from the National Defense Stockpile were processed in 2009 (USGS, 2010).

In 2005, Brush Engineered Materials, Inc. (the parent company) was awarded a contract under the Department of Defense's Defense Production Act, Title III Program for the engineering and design of a new facility for the production of primary beryllium, the feedstock material used to produce beryllium metal products. Construction of the new facility began in 2008 and will be finished in 2010 (USGS, 2010). The new facility is located at the existing plant site in Elmore, Ohio.

Gold and Silver

Gold production in 2009 is estimated to be about 580,000 troy ounces (oz), about 207,000 oz (55%) more than in 2008. The Barneys Canyon mine exhausted its economic ore reserves in late 2001 and ceased mining, but continued to produce gold from its heap-leach pads at a much-reduced rate in 2009. The leach pads are anticipated to be depleted in 2010. Silver is also a by-product metal from the Bingham Canyon mine. Silver production was about 4.9 million oz in 2009, about 1.5 million oz (44%) more than in 2008 (Rio Tinto, 2010). Several other small mines in the state may produce minor amounts of gold and silver, but production is not reported nor included in the above totals.

INDUSTRIAL-MINERALS PRODUCTION

Industrial-minerals production, with an estimated value of $955 million was the second-largest contributor to the value of minerals produced in 2009 (figure 2; table 1). The value of industrial minerals decreased $98 million (9%) in 2009 compared to 2008. Industrial-mineral values have grown substantially over the past 10 years, increasing from $500 million in 2000 to a record high of $1053 million in 2008 (table 1), a 97% increase. Commodities or commodity groups that have realized the majority of these gains include sand and gravel and crushed stone; Portland cement and lime; salines, including salt, magnesium chloride, potash (potassium chloride), and sulfate of potash (SOP); and phosphate rock. These commodities account for about 90% of the total value of Utah's industrial-minerals production. 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 decreased because of lower demand as a result of the economic downturn. However, several producers enjoyed near-record prices for their products, especially brine-derived products. Many producers project higher production levels and prices in 2010.

Salt, Magnesium Chloride, Potash (Potassium Chloride), and Sulfate of Potash

Brine-derived products, including salt, were the largest contributors to the value of industrial-mineral production in Utah in 2009, with a combined value of $445 million, about $69 million (18%) more than in 2008. In addition to salt, brine-derived products include magnesium chloride and potash (potassium chloride and potassium sulfate). One company (North Shore Limited Partnership) produces a small amount of concentrated magnesium brine that

is used as an ingredient in mineral food supplements. The statewide production of salt and other brine-derived products, excluding magnesium metal, is estimated to be 3.95 million mt (4.35 million st) in 2009, about 0.27 million mt (0.30 million st) more than in 2008. Potash production (including SOP) is estimated to be about 0.33 million mt (0.36 million st) in 2009, approximately 0.06 million mt (0.07 million st) less than in 2008.

Salt production was estimated to be 3.0 million mt (3.3 million st) in 2009, about 0.18 million mt (0.20 million st) more than in 2008, with most of the production coming from three operators processing brine from Great Salt Lake. The three largest operators are, in descending order of production: (1) Great Salt Lake Minerals Corporation, (2) Cargill Salt Company, and (3) Morton International. In addition, three other companies produce salt and/or potash from operations not located on Great Salt Lake: (1) Intrepid Potash-Wendover, LLC near Wendover in Tooele County (salt and potash), (2) Intrepid Potash-Moab, LLC near Moab in Grand County (salt and potash), and (3) Redmond Minerals, Inc. near Redmond in Sanpete County (rock salt).

Sand and Gravel, and Crushed Stone

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 2009, with an estimated value of $214 million, about $26 million (11%) lower than in 2008. These materials are produced in nearly every county in Utah by commercial operators as well as county, state, and federal agencies. Due to the large number of operations (approximately 140 active pits and quarries), the UGS does not send production questionnaires to this group. However, production data are compiled by the USGS. Based on preliminary 2009 data (Jason Willett, USGS, written communication, March 2010), Utah operators produced 28.1 million mt (31.0 million st) of sand and gravel valued at $169 million, and 4.83 million mt (5.32 million st) of crushed stone valued at $45 million. Crushed stone production includes raw materials for both lime and cement plants. This is a 3.7 million mt (4.1 million st) (12%) decrease in sand and gravel production and a 1.4 million mt (1.5 million st) (22%) decrease in the production of crushed stone compared to 2008. These decreases are mostly due to the decline in regional and local construction.

Portland Cement, Lime, and Limestone

Portland cement and lime were the third-largest contributors to the value of industrial minerals produced in 2009, with a combined value of $166 million, about $72 million (30%) less than 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 Lynndyl in Juab County. The companies have a combined capacity of more than 1.4 million mt (1.5 million st) of cement annually. Both plants operated below capacity in 2009, with total production of about 1.1 million mt (1.2 million st), about 0.37 million mt (0.41 million st) lower than in 2008. In addition to limestone, Ash Grove Cement mines a modest amount of shale and sandstone that are used in the manufacture of cement.

Lime production was about 33% lower in 2009 than in 2008, with an estimated production of about 483,000 mt (532,000 st). There are two suppliers of lime in Utah, with a combined capacity of more than 0.9 million mt (1.0 million st) per year: Graymont Western U.S., Inc., which produces dolomitic quicklime and high-calcium quicklime; and Lhoist North America (formerly Chemical Lime of Arizona), which produces dolomitic quicklime and hydrated dolomitic lime. Graymont Western's plant is in the Cricket Mountains, approximately 56 km (35 mi) southwest of Delta in Millard County, and is one of the 10 largest lime plants in the United States. Lhoist North America's plant is about 13 km (8 mi) northwest of Grantsville in Tooele County. The plant was idled in 2008 and remained idle during 2009.

Statewide, DOGM lists 36 active limestone operations including 15 Large Mine and 21 Small Mine permits. Total limestone production reported in 2008 was 4 million mt (4.4 million st). Most limestone is used in the manufacture of cement and lime products. Other uses of limestone include construction as well as flue-gas desulfurization in coal-fired power plants. A small amount of limestone is also pulverized and marketed as "rock dust" to the coal mining industry.

Phosphate

Simplot Phosphates, LLC is Utah's only phosphate producer. The company's phosphate operation is 18 km (11 mi) north of Vernal in Uintah County. The mine produces roughly 2.7 to 3.6 million mt (3–4 million st) of ore annually, which is processed into 0.9 to 1.8 million mt (1–2 million st) of phosphate concentrate. The concentrate is transported in slurry form to the company's Rock Springs, Wyoming, fertilizer plant via a 145-km (90 mile) underground pipeline. During 2009, the mine produced about 3.4 million mt (3.8 million st) of ore, nearly the same as in 2008.

Gilsonite

Gilsonite production for 2009 is estimated to be about 58,000 mt (64,000 st), a decrease of about 11,000 mt (12,000 st) over 2008. Gilsonite is an unusual solid hy-

drocarbon that has been mined in Utah for more than 100 years. Gilsonite is marketed worldwide for use in over 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 (1) American Gilsonite Company, (2) Lexco, Inc., and (3) Zeigler Chemical and Minerals Company. Although lower in 2009, gilsonite production has been increasing modestly over the past several years. American Gilsonite purchased the Lexco mine in mid-2009.

Expanded Shale

Expanded or "bloated" shale (a lightweight aggregate used mainly in the construction industry) is manufactured by roasting high-purity shale at temperatures near 2000°F. The intense heat causes the shale to expand and vitrify, creating a lightweight aggregate that is durable, uniform in size, and inert. Utelite, Inc. is the sole producer of this type of aggregate in the state. The mine and plant are located east of Wanship in Summit County. Utelite produced about 122,000 m^3 (160,000 yd^3) of expanded aggregate in 2009.

Common Clay, Bentonite, and High-Alumina Clay

Five companies produced approximately 200,000 mt (221,000 st) of common clay, bentonite, and high-alumina clay in 2009, approximately 64,000 mt (71,000 st) (24%) less than in 2008. Statewide, there were 18 active mine permits held by common clay, bentonite, and high-alumina clay operators in 2009. Many of these mines operate intermittently. The two largest producers of common clay in 2009 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 is 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 used only in the manufacture of Portland cement.

Gypsum

Three operators (down from seven in 2008) reported production of 140,000 mt (154,000 st) of gypsum in 2009, about 132,000 mt (146,000 st) (49%) less than in 2008. In descending order of production, the three producers were (1) U.S. Gypsum Company, (2) Sunroc Corporation (Clyde Companies), and (3) Diamond K Gypsum, Inc. Georgia Pacific Gypsum and U.S. Gypsum operate the only two wallboard plants in Utah; both plants are near the town of Sigurd in Sevier County. The Georgia Pacific plant, which reopened in 2006 after being closed since 2002, shut down again in early 2008 and remained closed during 2009. Most gypsum produced in Utah is used for making wallboard, but several operators supply raw gypsum to regional cement companies where it is 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 is directly related to the downturn of the housing industry in the Rocky Mountain region. Statewide there are nine active and eight inactive gypsum operations.

ENERGY MINERALS PRODUCTION

Coal

Seven Utah coal operators produced 19.9 million mt (21.9 million st) of coal valued at $635 million from eight underground mines in 2009 (figure 4). This production was 2.27 million mt (2.50 million st) (10%) less than in 2008. The mines and coal-related facilities are located in east-central Utah with the exception of the Coal Hollow mine (figure 5). Covol Technologies' Wellington air-sparge processing plant began operating in December 2005 and continued to process coal during 2009. Covol Technologies is a subsidiary of Headwaters, Inc., and the plant is rated at about 227 mt (250 st) per hour. The plant is located just south of the CV rail spur near Price. Arch Coal Company's Castle Valley coal preparation plant operated on an as-needed basis in 2009, and processed coal from the company's Skyline and Dugout mines. The plant is located along the CV spur and has the capacity to process up to 1.8 million mt (2.0 million st) of coal per year. Approximately 60% of Utah's coal is consumed in-state by three electric utility companies.

The largest coal producer was the Sufco mine, operated by Canyon Fuel Company, LLC, which produced 6.12 million mt (6.75 million st) of coal in 2009, slightly less than in 2008. In addition, the following four mines each produced in excess of 1.8 million mt (2.0 million st) of coal: (1) Skyline #3, operated by Canyon Fuel Company, LLC; (2) Deer Creek, operated by Energy West Mining Company (Rocky Mountain Energy); (3) Dugout Canyon, operated by Canyon Fuel Company, LLC; and (4) West Ridge, operated by West Ridge Resources.

Two new projects advanced toward production in 2009. UtahAmerican Energy's Lila Canyon mine received all required permits late in 2007, and access roads and site work were initiated in 2008 (see figure 5). The development of two rock slopes began in 2009 and will be completed in mid-2010. The mine is located in Emery County, about 8 km (5 mi) east of the town of Columbia (subdivi-

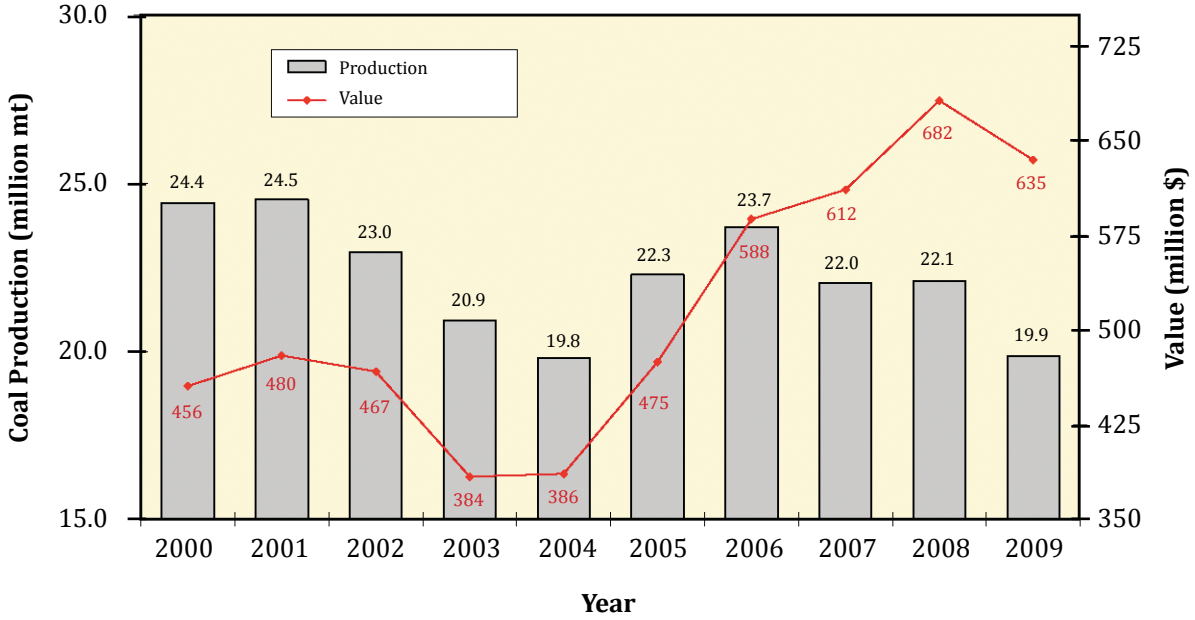

Figure 4. *Utah's annual coal production and value in nominal dollars, from 2000 through 2009.*

sion of East Carbon) (figure 5). Initial coal production is planned for 2011. Alton Coal Development LLC was granted a surface mining permit in mid-2009 for its Coal Hollow mine near the town of Alton in Kane County. However, no development plans have been announced for the new Coal Hollow mine.

Uranium

Denison Mines, Inc. and White Canyon Uranium Ltd. produced uranium and uranium/vanadium ore from four mines in southern Utah in 2009. The ore was trucked to Denison's White Mesa mill near Blanding in San Juan County where it was processed into uranium oxide (U_3O_8) and vanadium pentoxide (V_2O_5). The White Mesa mill is the only conventional uranium mill currently operating in the U.S. It is strategically located within hauling distance of most of the uranium mines in southern Utah, northern Arizona, and southwestern Colorado. Denison Mines produced approximately 106,000 mt (117,000 st) of uranium and vanadium ore in 2009 from three mines in San Juan County (Denison Mines, 2010) and White Canyon produced a nominal amount of uranium ore from its new (December 2009) Daneros mine in the Fry Canyon area in San Juan County. Denison's Tony M mine near the town of Ticaboo in eastern Garfield County remained idle during 2009. The White Mesa mill produced 278,000 kg (614,000 lb) of U_3O_8 from conventional ore and alternate feed, and 227,000 kg (501,000 lb) of vanadium from conventional ore in 2009 (Denison Mines, 2010).

EXPLORATION AND DEVELOPMENT ACTIVITY

Mineral exploration and development work continued at a somewhat slower pace in 2009 than in 2008. Most of the exploration efforts were focused on copper, molybdenum, gold, uranium, and potash. Commodity prices generally peaked in mid-2008, collapsed late that year, then gradually rebounded throughout 2009. The information in this section is largely derived from numerous individual mining company Web sites and press releases. A map showing the location of selected exploration areas in 2009 is shown in figure 6.

Claims, Leases, and Mine Permits

The number of new unpatented mining claims filed in Utah rose dramatically from a low of 508 in 2001 to over 7900 in 2007. Just over 1400 new claims were staked in Utah during 2009. Uintah (phosphate), Beaver (Cu), Tooele (Cu, Au), and San Juan (U) Counties each recorded over 150 new claims. At the end of 2009, the BLM had a total of more than 21,000 unpatented mining claims filed in Utah (Opie Abeyta, Utah BLM, written communication, March 2010).

The Utah School and Institutional Trust Lands Administration (SITLA), which manages about 1.8 million hectares (4.4 million acres) of state-owned lands in Utah, issued leases and/or contracts on 61 tracts in 2009. These were divided among the following commodities: metalliferous minerals (32), potash (15), sand and gravel (5), geothermal (2), volcanic material (2), gemstone/fossil (2), lime-

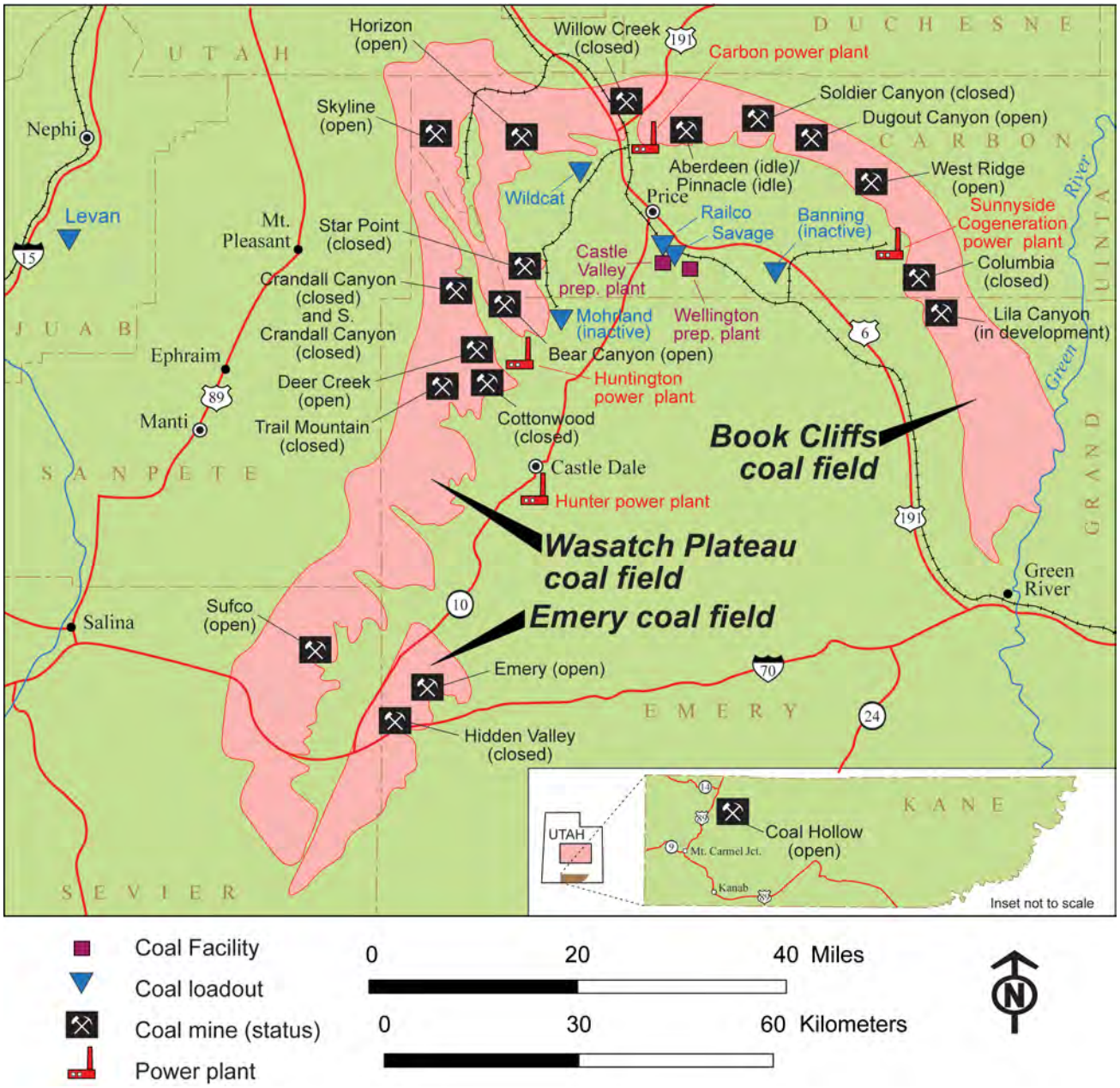

Figure 5. *Location and status of Utah's coal mines and processing plants. Data from DOGM files.*

stone (1), humic shale (1), and unclassified (1) (William Stokes, SITLA, written communication, March 2010).

During 2009, DOGM listed 114 (112 in 2008) active Large mines (including eight coal mines), and 195 (206 in 2008) active Small mines (excluding sand and gravel). In 2008, (DOGM has not yet received all production reports for 2009), 60 Large mines and 44 Small mines reported production, the same number of Large and Small mines reporting production in 2007. The Large mines reporting production in 2008, grouped by industry sector, were industrial minerals (42), base metals (5), precious metals (2), and energy minerals (11), including eight coal and three uranium. The Small mines reporting production in 2008, grouped by industry sector, were industrial minerals (32), precious metals (5), and gemstones, fossils, and other (7).

DOGM also received four new Large Mine permit applications and 15 new Small Mine permit applications in 2009. This is an increase of one Large Mine permit application and a decrease of 18 Small Mine permit applications compared to 2008. All four of the new Large Mine applications were for industrial-mineral operations. New Small Mine applications included industrial minerals (8), precious metals (5), base metals (1), and energy minerals (1).

The number of Notices of Intent (NOI) to explore on public lands decreased dramatically in 2009, with just 18 NOIs being filed with DOGM in 2009 compared to 64 for 2008,

and 53 for 2007. The 2009 NOIs included eight for energy minerals (all uranium), six for a combination of base and precious metals, one for base metals only, one for precious metals only, and one for gemstones, fossils, and other.

Base and Precious Metals

Base metals had another strong year in Utah in 2009. The Bingham Canyon mine continued to produce near-record profits, and a sediment-hosted copper solvent extraction-electrowinning operation in Lisbon Valley ramped back up toward full production in 2009. Base-metal exploration in 2009 was dominated by major companies doing brownfield exploration in the Bingham and Tintic mining districts.

Despite strong precious-metal prices, exploration activity in Utah for Au and Ag has waned, largely due to the inability of small exploration companies to raise funds during the recession in 2008 and 2009. Precious-metal exploration was largely focused in the eastern Basin and Range Province of western Utah.

Bingham Canyon

Kennecott Utah Copper Company's (KUC) Bingham Canyon mine was the largest producer of Cu and the second-largest producer of Mo in the U.S. in 2009. KUC also continued an aggressive development program with efforts concentrated on extending the mine life past the current 2020 plan, potentially to 2032. In late 2008, in-pit exploration resulted in the discovery of a major molybdenite deposit at depth. The new molybdenum resource was initially estimated at 500 to 600 million mt (550 to 660 million st) at grades ranging from 0.1 to 0.15% Mo (Rio Tinto, 2009), more than double the average Mo grade in the pit. KUC has delayed the projected startup date of a $275 million molybdenum autoclave process (MAP) facility from 2011 until 2012. The MAP plant will convert molybdenite concentrates to molybdenum trioxide (MoO_3) and ammonium dimolybdate $(NH_4)_2Mo_2O_7$. Construction of the plant will begin in 2010.

KUC brownfield exploration in the Oquirrh Mountains in 2009 included the addition of 140 magnetotelluric and 192 gravity stations to the existing grids. In addition, six deep core holes (totaling 9933 m [32,587 ft]) were drilled principally east and west of the Bingham pit. Exploration in the Oquirrh Mountains outside of the Bingham area included geologic mapping, geochemical sampling, and collecting magnetotelluric data from an additional 245 stations (Russ Franklin, Kennecott Exploration Company, written communication, March 2010). No analytical results have been released; however, the program resulted in the discovery of a new copper-molybdenum-gold porphyry system within 3 km (2 mi) of the Bingham Canyon mine (Rio Tinto, 2010).

Lisbon Valley Copper

The Lisbon Valley Mining Company began copper mine and leach pad development in 2005 with plant construction at the open-pit, heap leach, SX-EW Cu operation completed the following year. The operation endured metallurgical problems throughout 2007 and 2008 as it attempted to ramp up to full production. Fundamentally, the recovery of Cu from the pads was substantially slower than anticipated and the company was saddled with disadvantageous contracts. The operation continued to underachieve and mining was suspended in early 2008; however, leaching of the ore on the pads continued. Following bankruptcy, Lisbon Valley Mining Company LLC successfully restarted mining operations in 2009.

Tintic District

In 2008, Andover Ventures/Genco Resources purchased 65% of Chief Consolidated Mining Company. Chief Consolidated's main assets are in the East Tintic district, Utah County. Andover is drilling the Burgin Extension deposit to complete a Canadian NI 43-101 report on the historic resource of 1 million mt (1.1 million st) containing 565 ppm Ag, 21% Pb, and 6.7% Zn. In addition, Anglo American US, Inc. completed four holes on a porphyry Cu-Au-Mo lithocap on Big Hill near the center of the East Tintic district in 2008–09; drill results are not yet available.

Quaterra Resources, Inc. acquired about 1300 ha (3200 acres) of patented and unpatented mining claims covering the Southwest Tintic porphyry Cu system, Juab County, in 2007. The property hosts a known resource of approximately 360 million mt (400 million st) of 0.33% Cu and 0.01% Mo. This property was joint ventured with Freeport-McMoRan Exploration Corporation in 2009. Freeport began an integrated program of geological mapping, geochemical sampling, and geophysical surveying in 2009 that identified targets to be drill tested in 2010.

Crypto

Lithic Resources Ltd. acquired the Crypto Zn skarn in the Fish Springs mining district of western Juab County in 2005. In 2009, Lithic completed a 10,000-m (33,000 ft) core drilling program aimed at defining a new mineral resource within the skarn. New resource estimates (indicated and inferred) show a shallow oxide resource of 1.8 million mt (2.0 million st) averaging 8.73% Zn, 0.38% Cu, and 14.82 ppm In, and a deep sulfide resource of 8.7 million mt (9.6 million st) averaging 7.56% Zn, 0.41% Cu, and 46.82 ppm In. Metallurgical studies show the indium is contained in sphalerite in the sulfide resource.

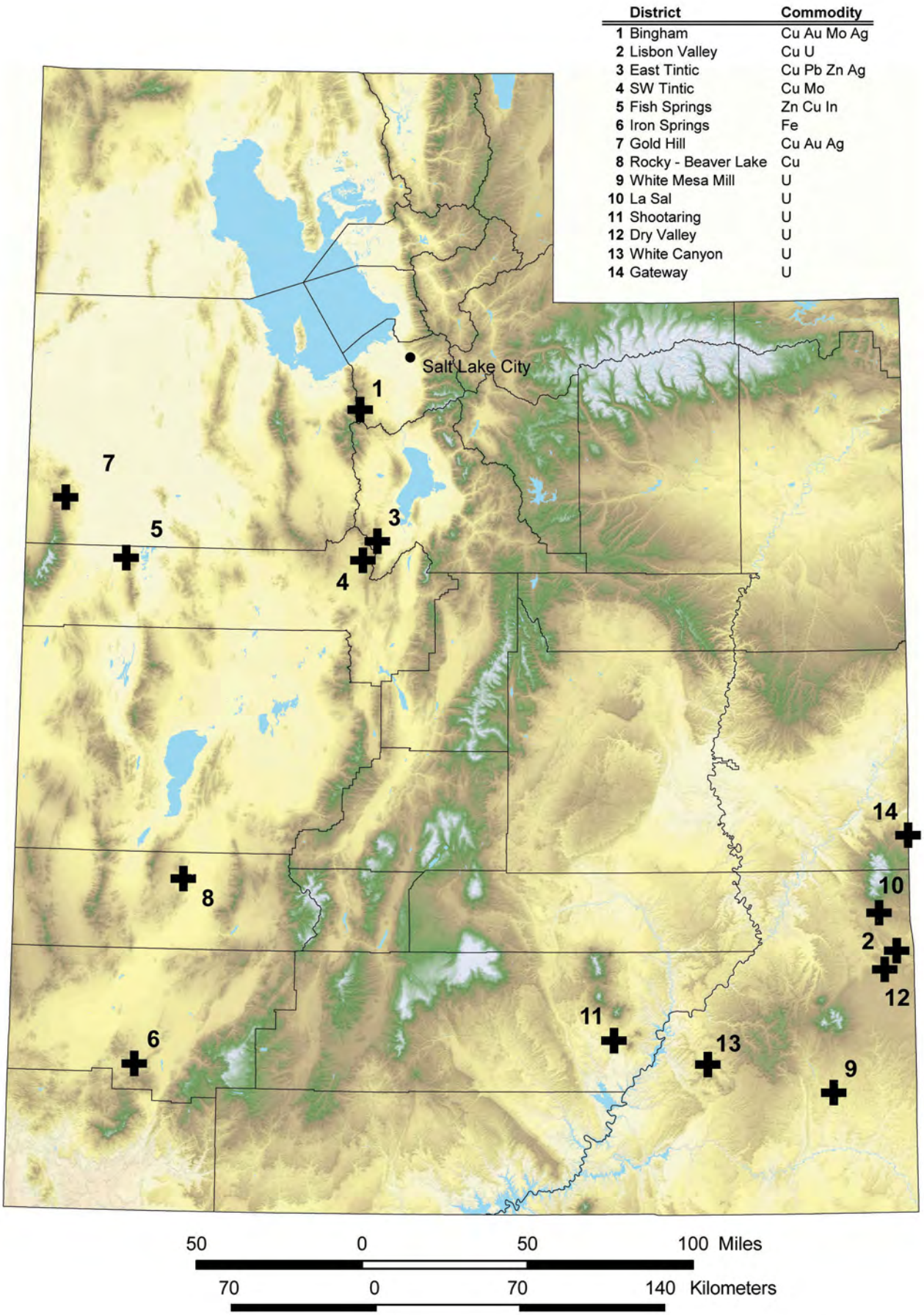

Figure 6. *Major base-metals, precious-metals, and uranium exploration areas in Utah in 2009.*

Iron Springs

In 2005, Palladon Iron Corporation acquired the Iron Mountain property (former Comstock-Mountain Lion open pit). The ore occurs as a massive magnetite replacement/skarn deposit adjacent to Miocene laccoliths. In 2009, Palladon completed a Canadian NI 43-101 compliant resource estimate on the Comstock–Mountain Lion deposit showing a resource of 28.4 million mt (31.4 million st) averaging 48.6% Fe. Although mining was initiated in 2008, Palladon ceased mining in 2009 due to instability in the iron ore market and the inability to locate a suitable export facility. Stockpiled ore remains at the newly completed rail load-out near the mine while the company reevaluates its production plans.

Gold Hill

Clifton Mining Company and Desert Hawk Gold Corp. have agreed to develop Clifton's mineral properties in the Gold Hill district. The preliminary work plan is to put the Yellow Hammer Cu-Au-Ag-W-Mo mine back into production. This small open pit is developed on an unusual skarn/breccia in a large Jurassic granodiorite stock. Chalcopyrite-cuprite-scheelite-molybdenite mineralization is associated with locally coarse-grained actinolite, tourmaline, garnet, orthoclase, titanite, apatite, and magnetite in argillically altered granodiorite. The ore will be processed at Clifton's existing 180 mt per day (200 st/d) Cactus gravity mill at Gold Hill. Initial production is anticipated in mid-2010.

Rocky–Beaver Lake

Copper King Mining Corporation, through its wholly owned subsidiary, Western Utah Copper Company, controls about 6200 ha (15,000 acres) in the Rocky and Beaver Lake mining districts near Milford. These districts host seven partially defined Cu skarn and breccia pipe deposits. In 2009, Copper King completed construction of an 1800 mt per day (2000 st/d) flotation mill and started mining the Hidden Treasure Cu skarn. The mill began production at about 1090 mt per day (1200 st/d) in May 2009 and produced a limited amount of copper concentrate (approximately 900 mt [1000 st]). A separate magnetite concentrate was produced and sold to Massey Energy for a coal wash plant in the fall of 2009. However, the mill experienced less than 50% Cu recovery due to the mixed oxide-sulfide nature of the skarn ore and halted operations near the end of 2009. Additional flotation cells are being added in the mill and a Cu cementation circuit is being considered for the mill tailings to improve Cu recovery, but the future of the operation remains uncertain until Chapter 11 bankruptcy proceedings are resolved.

Copper King also controls about 440 ha (1100 acres) of unpatented claims in the Drum (Detroit) mining district. This property includes several small historical Au-Ag mines.

Silver Dome

The Silver Dome property in the southern Fish Springs district is a 2020 ha (5000 acres) property acquired by Cordex for Columbus Silver Corp. Silver mineralization at Silver Dome is hosted in flat-lying Ordovician sandstones. The target at Silver Dome is bulk-minable Ag mineralization amenable to open-pit development. Columbus Silver completed 13 reverse-circulation holes totaling 1638 m (5375 ft) in a Phase I drilling program. Weak Ag mineralization was intersected, but no ore-grade intervals were cut.

Miscellaneous Base- and Precious-Metal Developments

Maestro Ventures acquired the Kings Canyon sediment-hosted Au-Ag property in southwestern Millard County in 2007. The property was explored in the early 1990s, primarily by Crown Resources. The property contains several known Au zones and the largest defined resource is about 6.2 million mt (6.8 million st) averaging roughly 1 ppm Au.

Inland Explorations Ltd. was formed in 2006 to conduct base-metal exploration in Utah. The company has aggressively pursued a grassroots exploration program and has acquired four properties to date: Thompson Knoll, Keg, Dugway, and Dunes (Sand Mountain).

Silver Verde May Mining Company acquired 82 claims and a 259 ha (640 acre) state lease covering a porphyry Cu-Mo system in the West Tintic mining district, Juab County. Silver Verde also controls 40 claims and a 271-ha (670 acre) state lease on a sediment-hosted Au target on the south flanks of Maple Peak, Juab County.

The Dome Hill project in the Keg Mountains is a sedimentary rock-hosted Ag prospect acquired by Cordex/Columbus Silver. This 400 ha (1000 acre) 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 have been completed.

In other base and precious metal developments in Utah: (1) Grand Central Silver Mines, Inc. continued work on a 46 ha (114 acre) tract on the southwestern fringe of the Bingham district, (2) RTM Exploration and Holdings LLC controls about 780 ha (1920 acre) of sediment-hosted Cu-Mo prospects in the Uinta Basin, (3) International Beryllium Corporation has acquired 371 claims adjacent to Brush-Wellman's Spor Mountain beryllium mine, Juab County, and (4) Unico, Inc. continued work on its Deer Trail Zn-Pb-Ag mine and small mill near Marysvale in Piute County.

Uranium

Utah historically was the third-largest uranium-producing state, with the majority of its production from the Colorado Plateau. The price of uranium oxide rose dramatically from a low of about $18/kg ($8/lb) in 2001 to $300/kg ($136/lb) in June 2007; however, the price fell to under $100/kg ($45/lb) by the end of 2009. Despite this, long-term contract uranium prices at the end of 2009 remained at approximately $141/kg ($64/lb) of U_3O_8. Uranium exploration and development activity in Utah has increased and decreased along with the spot prices. The following paragraphs report the major uranium events in Utah in 2009, and table 2 summarizes miscellaneous uranium activities.

Denison Mines Corp.

Denison Mines Corp. owns five permitted uranium mines in Utah as well as the 1800 mt per day (2000 st/d), dual-circuit (uranium-vanadium) White Mesa mill near Blanding. The mill processes both uranium ore and an alternate feed waste material. The mill began operating on stockpiled ore from Denison owned mines in 2008, and began accepting ore from other mining companies for toll milling in 2009. Uranium recoveries are averaging over 90%. The mill has the capacity to produce about 1.36 million kg (3 million lb) of U_3O_8 and 2 million kg (4.5 million lb) of V_2O_5 annually.

In late 2006, Denison's Pandora mine, in the eastern La Sal district, San Juan County, became the first Utah uranium property in production since 1991. The Pandora mine currently ships about 270 mt per day (300 st/d) 110 km (70 mi) south to the White Mesa mill. Reserves at the Pandora mine are estimated to be 263,000 mt (290,000 st) at 0.22% U_3O_8 and 1.1% V_2O_5. In 2009, Denison reopened the Beaver mine, 3 km (2 mi) west of the Pandora mine. The Beaver is producing about 200 mt per day (220 st/d) from a resource estimated at 680,000 mt (750,000 st) at 0.2% U_3O_8 and 1.25% V_2O_5 The La Sal district uranium ores are hosted in the Upper Jurassic Salt Wash Member of the Morrison Formation.

Denison's Henry Mountains Complex (Tony M mine and Bullfrog properties) in the Shootaring Canyon district, Garfield County, hosts the largest known uranium resource in Utah, estimated to be about 1.527 million mt (1.684 million st) averaging 0.24% U_3O_8. The mine was developed in 1977, and when it was shut-down in 1985, had nearly 27 km (17 mi) of underground workings. The mine was rehabilitated and random room-and-pillar mining resumed in late 2007, ramping up toward 520 mt per day (575 st/d). However, declining uranium prices and lower than anticipated head grades forced its closure in November 2008. Approximately 18,000 mt (20,000 st) of ore remain stockpiled at the Henry Mountains Complex. The mine has a 197 km (122 mi) haul to the White Mesa mill.

In 2008, production began at Denison's Rim mine in the Dry Valley (East Canyon) district of San Juan County. The Rim mine began operating at about 45 mt per day (50 st/d) with reserves estimated at 136,000 mt (150,000 st) at 0.22% U_3O_8 and 2% V_2O_5. However, the Rim mine was put on standby in March 2009. Both the Shootaring and Dry Valley district uranium ore bodies are hosted in the Upper Jurassic Salt Wash Member of the Morrison Formation.

White Canyon Uranium Ltd.

White Canyon Uranium Ltd. has done a remarkable job of development in a short period of time. The Daneros mine in the White Canyon district in San Juan County was permitted in May 2009, development began in July, and mining was initiated in December 2009. The Daneros ore body has an estimated resource of 190,000 mt (210,000 st) at 0.3% U_3O_8. The mine is accessed by twin declines, developed by room and pillar methods, has ten active mine faces, and is ramping up production to 50,000 mt per year (55,000 st/yr). Ore is shipped 101 km (63 mi) to the White Mesa mill for toll milling. The White Canyon district ores are hosted by the basal Shinarump Conglomerate Member of the Upper Triassic Chinle Formation and typically contain about 1% copper.

Energy Fuels, Inc.

Energy Fuels, Inc. is also exploring and rehabilitating its historical uranium mines. The Whirlwind mine on Beaver Mesa straddles the Utah-Colorado border about 45 km (28 mi) northeast of Moab in Grand County. The property began limited production in 2009, but is currently on standby. The Whirlwind resource is about 149,000 mt (164,000 st) of ore averaging 0.20% U_3O_8 and 0.66% V_2O_5. Energy Fuels anticipates mining 45 to 180 mt per day (50 to 200 st/d) when mining resumes.

In 2007, Energy Fuels acquired the 284 ha (702 acre) Hecla Shaft mine, near La Sal, San Juan County and began rehabilitation. The mine, renamed the Energy Queen, has an estimated resource of 234,000 mt (258,000 st) of ore averaging 0.24% U_3O_8 and 0.96% V_2O_5, with access via an existing 229-m-deep (750 ft) lined shaft. Both the Whirlwind and Energy Queen uranium ores are hosted in the Upper Jurassic Salt Wash Member of the Morrison Formation.

Uranium One, Inc.

Uranium One, Inc. acquired the uranium assets of the U.S.

Table 2. *Uranium Projects in Utah, 2009.*

Property	District	County	Company	Progress
Deep Gold	San Rafael River	Emery	Energy Fuels, Inc.	Indicated resource: 308,800 tons @ 0.272% U_3O_8
Down Yonder	San Rafael River	Emery	Energy Fuels, Inc.	Indicated resource: 199,100 tons @ 0.18% U_3O_8
Green River South (Sahara)	San Rafael River	Emery	Titan Uranium, Inc.	12,560 ft drilled in 20 holes, including 3 ft @ 0.276% U_3O_8
Sahara	San Rafael River	Emery	Uranium One, Inc.	Resource: 109,000 tons @ 0.23% U_3O_8
Four Corners	San Rafael Swell	Emery	International Ranger Corp.	Acquired 47,120 acres
Frank M	Henry Mountain	Garfield	Uranium One, Inc.	Resource: 1.5 M tons @ 0.12% U_3O_8
North Wash	Henry Mountain	Garfield	Vane Minerals Plc.	29 holes drilled, including 9.5 ft @ 0.36% U_3O_8
Tony M/Bullfrog Mine	Henry Mountain	Garfield	Denison Mines Corp.	Permitted resource: 1.527 M tons @ 0.24% U_3O_8
Whirlwind Mine	Beaver Mesa	Grand	Energy Fuels, Inc.	Permitted resource: 656,000 lb U_3O_8
Thompson Project	Thompson	Grand	White Canyon Uranium Ltd.	Acquired 6672 acres
Koorsharem	Marysvale	Piute	International Ranger Corp.	Acquired 120 acres
Dunn	Dry Valley	San Juan	Midasco Capital Corp.	Resource: 143,400 tons @ 0.12% U_3O_8
Rim-Columbus Mine	Dry Valley	San Juan	Denison Mines Corp.	Permitted resource: 660,000 lb U_3O_8
Marcy-Look	Elk Ridge	San Juan	White Canyon Uranium Ltd.	Acquired 907 acres
Blue Jay	Fry Canyon	San Juan	White Canyon Uranium Ltd.	Acquired 289 acres
Energy Queen Mine (Hecla Shaft)	La Sal	San Juan	Energy Fuels, Inc.	Permitted resource: 1.2 M lb U_3O_8
La Sal	La Sal	San Juan	Vane Minerals Plc.	Acquired 80 acres
North Alice Extension	La Sal	San Juan	Vane Minerals Plc.	Resource: 43,000 tons @ 0.14% U_3O_8
Pandora/Snowball Mine	La Sal	San Juan	Denison Mines Corp.	In production: 1.2 M lb U_3O_8 reserve
Dar	Lisbon Valley	San Juan	Mesa Uranium Corp.	1000 acre property
Lisbon mine	Lisbon Valley	San Juan	Mesa Uranium Corp.	22 holes (~60,000 ft), including 3.5 ft @ 0.28% U_3O_8
Velvet Mine	Lisbon Valley	San Juan	Uranium One, Inc.	Permitted resource: 580,000 lb U_3O_8
Calliham (J.H. Ranch)	Ucolo	San Juan	Midasco Capital Corp.	Resource: 170,000 tons @ 0.20% U_3O_8
Crain	Ucolo	San Juan	Uranium Energy Corp.	Resource: 33,000 tons @ 0.21% U_3O_8
Daneros Mine (Lark Royal)	White Canyon	San Juan	White Canyon Uranium Ltd.	In production: 1.2 M lb U_3O_8 resource
Geitus	White Canyon	San Juan	White Canyon Uranium Ltd.	Resource: 40,000 ton @ 0.3% U_3O_8
Happy Jack	White Canyon	San Juan	Vane Minerals Plc.	22 holes completed, including 1.5 ft @ 0.39% U_3O_8
LaSal	Lisbon Valley	San Juan	Laramide Resources Ltd.	Resource: 440,000 tons @ 0.31% U_3O_8

Energy Corp. in 2006 and Energy Metals in 2007. These assets included the 680 mt per day (750 st/d) Shootaring Canyon (Ticaboo) uranium mill in the Henry Mountains district, Garfield County. Other assets included the Velvet mine (64,260 mt [70,850 st] averaging 0.41% U_3O_8 and 0.57% V_2O_5) in the Lisbon Valley district. Velvet ores are hosted in the Lower Permian Cutler Group sandstone.

Industrial Minerals

In addition to the usual base metal, precious metal, and uranium exploration and development in Utah, 2009 also saw an increase in industrial minerals exploration activity. Simplot Phosphates LLC staked over 200 new claims in Uintah County for phosphate. Several companies have acquired parcels totaling over 500 sq km (200 mi^2) of ground and are exploring for potash brines in the Paradox Basin of southeastern Utah. Mesa Uranium Corporation announced that it has acquired approximately 2400 ha (6000 acres) of property at its Green Energy lithium brine project, which is also in the Paradox Basin.

NEW MINERALS INFORMATION

The following publications provide new information on the mineral resources of Utah. These and others publications are available through the Utah Department of Natural Resources Map and Bookstore (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.

Geology and Geologic Resources and Issues of Western Utah is a new CD published in 2009 by the Utah Geological Association as Publication 38, edited by Bryce T. Tripp, Ken Krahulec, and J. Lucy Jordan. In addition to 10 papers on mineral resources and nine on water resources, the volume also contains a series of papers on geology, stratigraphy, and geophysics. The CD also includes papers on Bingham Canyon mine expansion, geology of the Crypto zinc skarn, Iron Mountain iron resources, Kings Canyon gold mineralization, Keg Mountain exploration, Gold Mountain mining district, saline resources, and three historical mineral resource papers.

New minerals related publications by the Utah Geological Survey include:

- *2008 Summary of Mineral Activity in Utah*, by Roger L. Bon and Ken Krahulec, Circular 109, CD, 14 p.
- *Utah Renewable Energy Zones Task Force — Phase I Report: — Renewable Energy Zone Resource Identification*, by Jason Berry, David Hurlbut, Richard Simon, Joseph Moore, and Robert Blackett, Miscellaneous Publication 09-1, CD, 56 p.
- *Annotated Bibliography of Utah Tar Sands and Related Information — Updated 2009*, by J. Wallace Gwynn and Francis V. Hanson, Open-File Report 503, 143 p.
- *Strategies for In Situ Recovery of Utah's Heavy Oil and Bitumen Resources,* by Steven Schamel, Open-File Report 551, CD, 113 p.

RECLAMATION AND THE ENVIRONMENT

The U.S. Department of Energy (DOE) and the State of Utah have agreed to move the 10.8 million mt (11.9 million st) of Atlas uranium mill tailings located along the Colorado River near Moab. The tailings, sitting on a 52-ha (130 acre) site, are estimated to average about 100 ppm uranium and 400 ppm vanadium (Don Metzler, verbal communication, March 2007). The tailings will be moved 48 km (30 mi) north to a site near Crescent Junction. DOE will transport the tailings by rail to a 100-ha (250 acre) disposal cell developed in the Cretaceous Mancos Shale. The $1 billion reclamation project began shipping tailings in April 2009, spent over $100 million on the effort in 2009, and has an anticipated completion date of 2028.

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