2005 Summary of Mineral Activity in Utah

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SUMMARY

The value of Utah's mineral production (including coal) in 2005 is estimated to be a record $3.58 billion, $1.26 billion (54%) higher than the revised value of $2.32 billion for 2004. All major industry segments gained in value in 2005. Contributions from each of the segments were as follows: base metals, $2.13 billion (60% of total); industrial minerals, $758 million (21% of total); coal, $468 million (13% of total); and precious metals, $229 million (6% of total) (figure 1; table 1). Compared to 2004, the 2005 values of (1) base metals increased $990 million (87%), (2) industrial minerals increased $115 million (18%), (3) coal increased $80.7 million (21%), and (4) precious metals increased $70.8 million (45%). Over the 10-year period from 1996 through 2005, the estimated value of Utah's mineral industry has ranged from a low of $1.76 billion to the current record high of $3.58 billion (table 1).

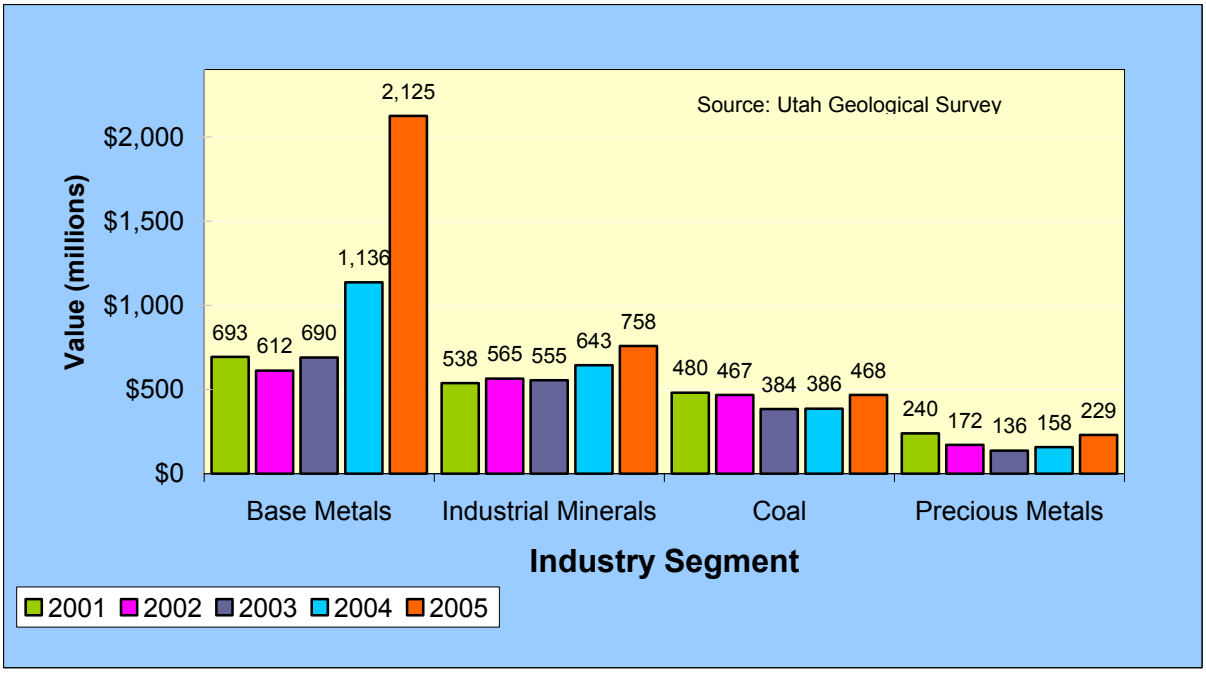

Figure 1. Value of Utah's mineral production from 2001 through 2005.

Preliminary estimates from the U.S. Geological Survey (USGS) rank Utah 4th nationally in the value of nonfuel minerals produced in 2005, and Utah accounted for about 5.6% of the total U.S. nonfuel mineral production value (Tanner, 2006). Based on Energy Information Administration data, Utah ranked 15th in coal production in 2005 (Energy Information Administration, 2006).

The outlook for 2006 is cautiously optimistic. The value of mineral production is projected to increase slightly in 2006 due to increased production of most base and precious metals, coal, and most major industrial minerals. Most base- and precious-metal prices increased

significantly in 2003, 2004, and 2005 and should remain near or above their respective 2005 averages during 2006, except for molybdenum, which is expected to fall. Industrial-mineral prices should also remain near their current levels as Utah's economic recovery continues, although a reduction in demand for several commodities is projected. Coal prices and production should increase as new coal contracts are being negotiated at significantly higher prices.

Increasing metal prices have lead to substantially increased mineral exploration and development in Utah. In addition to the important expansion of ore reserves at Bingham (Cu-Mo-Au) and the initiation of mining at Lisbon Valley (Cu), advanced stage exploration and development are occurring in the Iron Springs (Fe) and Rocky Range-Beaver Lake (Cu-Au) mining districts.

During 2005, the Utah Division of Oil, Gas and Mining (DOGM) received 10 Large Mine permit applications (2 ha [5 acres] and larger disturbance) and 37 new Small Mine permit applications (less than 2 ha [5 acres] disturbance). The 10 Large Mine permit applications include two new mine applications and eight applications to change from a Small Mine permit to a Large Mine permit. All of the Small Mine permits are for new operations. Mineral exploration statewide significantly increased in 2005. Twenty-seven Notices of Intent (NOI) to explore on public lands were filed with DOGM in 2005, compared to 14 in 2004, 23 in 2003, and 11 in 2002. The number of new federal unpatented mining claims recorded in Utah reached a 14-year high.

Utah was again rated as one of the best states for mining development as reported in the 2004/2005 Fraser Institute survey of mining companies. The Fraser survey includes 14 U.S. states, 12 Canadian provinces and territories, and 37 other countries. According to the Fraser Institute, Utah has the best taxation regime (tie) and is fourth in terms of favorable overall governmental policies.

OUTLOOK

The overall value of mineral production in Utah is expected to remain nearly the same in 2006 as it was in 2005, as projected base- and precious-metal production increases may be offset by lower prices for select base metals, especially molybdenum, whose remarkable price run-up to $14.89/kg ($32.76/pound) in 2005 is unlikely to be repeated in 2006. Industrial-mineral production is expected to be flat to slightly higher as many operators are operating at or near capacity. Overall, industrial mineral prices, will continue to increase as demand nationwide for most industrial minerals will increase in 2006. The value of coal will increase as production and prices are expected to increase as new contracts replace existing contracts at significantly higher rates. The opening of the Lisbon Valley base-metal mine in late 2005 will add incrementally to the state's base-metal values in 2006 and beyond. Precious-metal production will be higher in 2006 due to increased production from Kennecott's Bingham Canyon mine, but will be partially offset by lower gold production from the company's Barneys Canyon mine. Continued high base- and precious-metal prices should increase exploration for these metals over the next few years.

MINE PERMIT SUMMARY

During 2005, DOGM received 10 Large Mine permit applications (2 ha [5 acres] and larger disturbance) and 37 new Small Mine permit applications (less than 2 ha [5 acres] disturbance). Nine of the Large Mine permit applications were for industrial minerals and one permit application was for base metals. Eight of the Large Mine permit applications requested a change from a Small Mine permit to a Large Mine permit, and two applications were for new mines. The 37 Small Mine permit applications included 30 industrial mineral; three energy mineral; two gems, geodes, fossils, and other; one precious-metal; and one base-metal operation. The number of Large Mine applications was three more than in 2004; Small Mine applications were 19 more than in 2004.

Reported mine production for 2005 is incomplete. In 2004, DOGM recorded production from 75 Large Mines (excluding sand and gravel), five fewer than in 2003. The Large Mines included three base-metal mines, two precious-metal mines, 13 coal mines, and 57 industrial-mineral mines (including gems, geodes, fossils, and other). Seventy-six Small Mines reported production in 2004, four fewer than in 2003. These Small Mines included 50 industrial-mineral; 20 gems, geodes, fossils, and other; and six precious-metal operations.

The School and Institutional Trust Lands Administration, which manages the mineral resources on about 1.8 million ha (4.5 million ac) of state-owned lands in Utah, reported issuing leases and/or contracts for the following commodities in 2005: (1) bituminous/asphaltic sands-17, (2) building stone-10, (3) gemstone/fossil-1, (4) gilsonite-2, (5) gypsum-1, (6) limestone-2, (7) metalliferous minerals-127, (8) oil shale-22, and (9) sand and gravel-17.

NATIONAL RANKINGS

The USGS's 2005 preliminary data has ranked Utah 4th in the nation in the value of nonfuel mineral production, compared to 6th in 2004. USGS data show that Utah accounted for 5.6% of the total U.S. nonfuel mineral production value, compared to a revised 4.25% in 2004 (Tanner, 2006). For 2005, USGS data show that Utah remained the only state that produced beryllium concentrates and magnesium metal. Additionally, Utah was second in the quantity of molybdenum concentrates, copper, gold, potash, and magnesium compounds produced (in descending order of value); fourth in phosphate rock and silver; and sixth in salt (Tanner, 2006). The state was also a significant producer of Portland cement, construction sand and gravel, lime, common clays, and gemstones.

The USGS's preliminary estimate of the value of nonfuel mineral production for 2005 is $2.87 billion (Tanner, 2006), about $920 million (48%) higher than in 2004. USGS data show that between 2002 and 2005 the value of nonfuel mineral production in Utah increased from $1.24 billion (a 10-year low) in 2002 to a record high $2.87 billion in 2005 (figure 2). The Utah Geological Survey's (UGS) estimate for the value of nonfuel mineral production for 2005 is $3.11 billion, compared to $1.94 billion for 2004.

A summary of estimated mineral values by the UGS from 1996 through 2005 is shown in table 1.

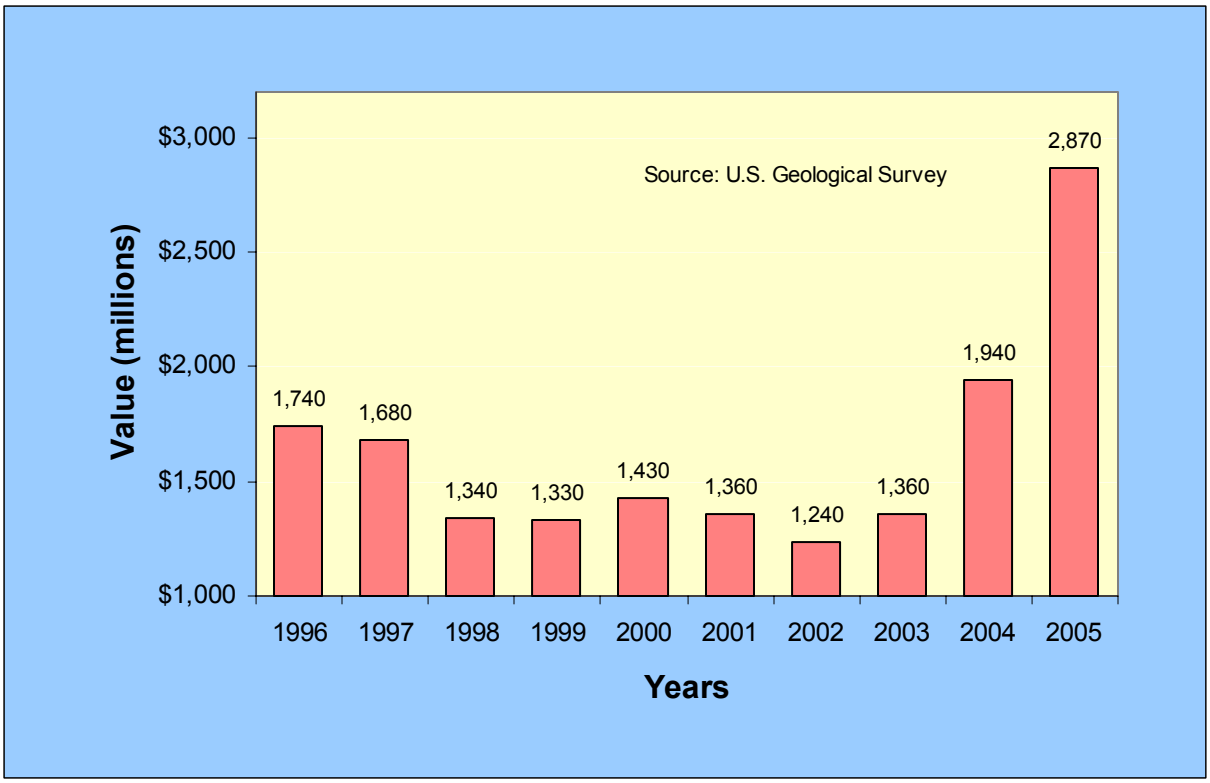

Figure 2. Value of Utah's nonfuel mineral production from 1996 through 2005.

Table 1. Utah mineral production values by industry segment from 1996 through 2005. Estimated value is in millions. Note that totals may not add up correctly due to rounding.

Year	Base Metals	Industrial Minerals	Coal	Precious Metals	Total Value
1996	$929	$434	$500	$326	$2,190
1997	$941	$533	$485	$289	$2,247
1998	$688	$534	$474	$154	$1,850
1999	$626	$583	$460	$153	$1,822
2000	$749	$500	$456	$212	$1,916
2001	$693	$538	$480	$240	$1,951
2002	$612	$565	$467	$172	$1,815
2003	$690	$555	$384	$136	$1,765
2004	$1,136	$643	$386	$158	$2,324
2005	$2,125	$758	$468	$229	$3,580

BASE- AND PRECIOUS-METAL PRODUCTION

Base-metal production, with an estimated value of $2.13 billion, was the largest contributor to the value of minerals produced in 2005, an all-time high (figure 1; table 1). In descending order of value, those metals were molybdenum, copper, magnesium, and beryllium. The 2005 base-metal values were about $990 million (87%) more than 2004. This increase is on top of a 65% increase in the value of base-metal production in 2004. Precious-metal production,

valued at $229 million (figure 1; table 1), included gold (87% of total value) and silver (13% of total value). Precious-metal values in 2005 were $70.8 million (45%) higher than in 2004.

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 combined value of minerals produced from the Bingham Canyon mine in 2005 was about 63% of the total value of all minerals produced statewide. KUC has an aggressive mine expansion program ongoing.

Molybdenum

For the first time, molybdenum was the largest contributor to the value of Utah's base-metal production in 2005. Kennecott's Bingham Canyon mine produced about 15,600 metric tons (mt) (17,200 short tons [st]) of by-product molybdenum in 2005, 130% more than in 2004 (Rio Tinto, 2006). The increased production of molybdenum, in conjunction with the massive increase in molybdenum price, supplanted copper as the most valuable mineral product from the century-old porphyry copper-molybdenum-gold-silver operation. The Bingham Canyon mine was one of only eight molybdenum-producing mines in the U.S. in 2005. The USGS reports that in the U.S., mine output of molybdenum increased 35% in 2005, on top of a 19% increase in 2004 (Magyar, 2006). According to Rio Tinto (2006), the substantial increase in molybdenum production in 2005 was in response to increased world-wide demand.

Copper

Copper is the second-largest contributor to the value of nonfuel minerals in Utah. Substantial price increases in 2003, 2004, and 2005 raised the value of copper to an all-time high, and the value of base-metal production statewide to more than $2 billion for the first time. From 2002 through 2005, the average annual price of copper increased from $1.67/kg ($0.76/lb) to $3.72/kg ($1.69/lb). Refined copper production from Kennecott's Bingham Canyon mine decreased slightly in 2005 to approximately 232,000 mt (255,200 st) from approximately 247,000 mt (272,000 st) in 2004. Kennecott also reports that the Bingham Canyon mine produces more than 10% of the annual refined copper requirements in the U.S. (Rio Tinto, 2006).

The Lisbon Valley Copper mine, located 72 km (45 mi) southeast of Moab in San Juan County, began operating in December 2005, and is scheduled to produce about 18 million kg (40 million lb) of copper in 2006 (Greg Hahn, Constellation Copper, written communication, March 2006).

Gold and Silver

Refined gold production in 2005 is estimated to be about 401,000 Troy ounces (oz), a 30% increase from the 308,000 oz produced in 2004. Gold is produced from two surface mines owned by Kennecott Corporation: one primary producer (Barneys Canyon mine) and one by-product operation (Bingham Canyon mine), both located in Salt Lake County. Several other small mines in the state are known to produce minor amounts of gold and silver, but metal-specific production is not reported, and not included in the above totals. The Barneys Canyon mine exhausted its economic ore reserves in late 2001 and ceased mining, but will continue to

produce gold from its heap-leach pads at a much reduced rate into 2007, when those pads will be depleted. Silver is also a by-product metal from the Bingham Canyon mine. Refined silver production was 3.54 million oz in 2005, about 6% higher than in 2004.

Magnesium

Magnesium metal was the third-largest contributor to the value of base metals in 2005. 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 2005 was slightly lower than in 2004. Due to market conditions, the planned expansion to 54,000 mt (59,500 st) announced last year has been delayed indefinitely. Magnesium metal prices declined from $3.48/kg ($1.58/lb) in 2004 to $2.98/kg ($1.35/lb) in 2005 (Kramer, 2006).

Beryllium

Utah continues to be the nation's sole producer of beryllium concentrates. Beryllium ore (bertrandite) is mined at Brush Resources' Topaz and Hogs Back mines in Juab County and processed along with imported beryl 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 Ohio, where it is converted into beryllium metal, alloys, and oxide. No bertrandite ore was mined in 2005, but about 36,000 mt (40,000 st) of stockpiled and purchased ore was milled at the Delta plant. Shedd (2006) estimates that nearly one-half of beryllium use is in computer and telecommunications products, and the remainder is used in aerospace and defense applications, appliances, automotive electronics, industrial components, and other applications.

Brush Wellman (parent company) announced that it has received a $9 million contract award under the Department of Defense's Defense Production Act, Title III Program. The contract is for the engineering and design of a new facility for the production of primary beryllium, the feedstock material used to produce beryllium metal products. The awarding of the contract represents a key step toward the return of a sustainable domestic supply of beryllium, a material critical to the nation's strategic interests. The new facility, to be owned and operated by Brush Wellman, will be located at an existing plant site in either Elmore, Ohio or Delta, Utah. The total cost of the facility is expected to range from $40 to $60 million and approximately 25 additional jobs are expected to be created to operate and maintain the facility (Brush Wellman, 2006).

INDUSTRIAL-MINERALS PRODUCTION

Industrial-minerals production, with an estimated value of $758 million (an all-time high) was the second-largest contributor to the value of minerals produced in 2005 (figure 1; table 1). The value of industrial minerals has grown substantially over the past 10 years, increasing from $434 million in 1996 to $758 million this past year, a 75% 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 89% of the total value of the industrial minerals segment. Other important commodities produced in Utah, in descending order of value, include gilsonite, expanded shale, common clay, bentonite and kaolinite, and gypsum.

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

Brine-derived products, including salt, were the highest contributors (up from third-highest in 2004) to the value of industrial-mineral production in Utah during 2005, with a combined value of $262 million, about $83 million (46%) more than in 2004. Most of the increase in value is due to a substantial increase in the production of potash. In addition to salt, brine-derived products include magnesium chloride and potash (potassium chloride and potassium sulphate [SOP]). One company (North Shore Limited Partnership) produces a small amount of concentrated 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 2.70 million mt (2.98 million st) in 2005, about 0.73 million mt (0.80 million st) less than in 2004. Potash production (including SOP) is estimated to be about 0.84 million mt (0.93 million st) in 2005, approximately 395,000 mt (435,000 st) more than in 2004.

Salt production alone is estimated to be 2.63 million mt (2.90 million st) in 2005, about 63,500 mt (70,000 st) more than in 2004, 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) Reilly Chemical Company at Wendover in Tooele County (salt and potash), (2) Moab Salt, LLC near Moab in Grand County (salt and potash), and (3) Redmond Minerals, Inc. near Redmond in Sanpete County (rock salt).

Portland Cement and Lime

Portland cement and lime were the second-highest contributors (same as 2004) to the value of industrial minerals produced in 2005, with a combined value of $192 million, about $12 million (7%) more than in 2004. Two operators produce Portland cement in Utah: Holcim, Inc. and Ash Grove Cement Company. Holcim's Devils Slide mine and plant are east of Morgan in Morgan County, and Ash Grove's Leamington mine and plant 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 at or above design capacity in 2005, with total production of about 1.5 million mt (1.7 million st). In addition to limestone, both Holcim and Ash Grove Cement mine modest amounts of shale and sandstone that are used in the manufacture of cement.

Lime production was about 10% higher in 2005 than in 2004, with an estimated production of about 726,000 mt (800,000 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 quick lime and high-calcium quick lime; and Chemical Lime of Arizona, Inc., which produces dolomitic quick lime 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 (35 mi) southwest of Delta in Millard County, and is one of the 10 largest lime plants in the United States. Chemical Lime of Arizona's plant is about 13 km (8 mi) northwest of Grantsville in Tooele County.

In 2004, an additional 13 to 15 operators quarried about 2.0 million mt (2.2 million st) of limestone and dolomite, which was used mainly for construction as well as flue-gas desulfurization in coal-fired power plants. A small amount of limestone and dolomite is also crushed to a fine powder and marketed as "rock dust" to the coal mining industry.

Sand and Gravel and Crushed Stone

Sand and gravel, and crushed stone (including limestone and dolomite) were the third-highest contributors to the value of industrial minerals produced in Utah during 2005 (down from highest in 2004), with an estimated value of $186 million, about $16 million (9%) higher than in 2004. These materials are produced in nearly every county in Utah by commercial operators, and by federal, state, and county 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 fourth quarter 2005 production data (Willett and Bolen, 2006), the USGS estimates that 2005 production will be 30.7 million mt (33.8 million st) of sand and gravel with a value of $135 million, and 8.8 million mt (9.70 million st) of crushed stone with a value of $51.1 million. Crushed stone production includes raw material for both lime and cement plants. This is a 3% increase in sand and gravel production and a 9.7% increase in the production of crushed stone compared to 2004.

Phosphate

Simplot Phosphates, LLC (formerly SF Phosphates, Ltd) 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 144-km- (90-mi-) long underground pipeline. During 2005, the mine produced about 3.4 million mt (3.8 million st) of ore, about the same as in 2004.

Gilsonite

Gilsonite production for 2005 is estimated to be about 73,000 mt (80,000 st), about 9,100 mt (10,000 st) more than in 2004. Gilsonite is an unusual solid hydrocarbon that has been mined in Utah for more than 100 years. 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) Zeigler Chemical and Minerals Company, and (3) Lexco, Inc. Gilsonite is marketed worldwide for use in over 150 products ranging from printing inks to explosives. Gilsonite production has been increasing modestly over the past several years.

Expanded Shale and Perlite

Two companies, Utelite, Inc., and Basin Perlite, produced lightweight "expanded" products from shale and pumice for use primarily in the construction and building industries. Mine production was about 248,000 mt (273,000 st) in 2005, a slight increase from 2004. Utelite's mine is east of the town of Wanship in Summit County. The Basin Perlite mine, located north and west of the town of Milford in Beaver County, was shut down in March 2005, and is inactive.

Common Clay and Bentonite

Nearly 300,000 mt (331,000 st) of common clay and approximately 62,000 mt (68,000 st) of bentonite were produced by eight companies in 2005, a 7% increase in common clay and a 38% decrease in bentonite compared to 2004. Statewide, there were 21 active mine permits held by clay operators in 2005. Many of these mines operate intermittently. The two largest producers of common clay in 2005 were Interstate Brick Company and Interpace Industries. Two companies (Western Clay Company and Redmond Minerals, Inc.) produce bentonite from pits located in central Utah. 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 an additive in oil and gas drilling fluids, and as a binder in foundry molds. ECDC Environmental, LLC intermittently produces clay for use at their waste disposal facility near the town of East Carbon in Carbon County.

Gypsum

Four companies produced about 390,000 mt (430,000 st) of gypsum in 2005, about 9100 mt (10,000 st) more than in 2004. In descending order of production, the three largest producers were (1) U.S. Gypsum Company, (2) H.E. Davis and Sons, and (3) Nephi Gypsum, Inc. U.S. Gypsum operates the only active wallboard plant in Utah. The plant is located near the town of Sigurd in Sevier County. The Georgia Pacific plant, also near Sigurd, closed in 2002 and the company's mines in Utah are inactive. Statewide, there are only five active gypsum mines.

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.

ENERGY MINERALS PRODUCTION

Coal

Utah's coal operators produced 22.2 million mt (24.5 million st) of coal valued at $468 million from 13 underground mines in 2005 (figures 1, 3, and 4; table 1). This production was approximately 2.5 million mt (2.8 million st), or 13% more than in 2004. All of the mines and coal-related facilities are located in east-central Utah (figure 3). Utah's synfuel plant, DTE Utah Synfuels, LLC, is the only synfuel facility west of the Mississippi River. The synfuel plant is located at the Castle Valley (CV) railroad spur near the town of Wellington. The plant operated

on a full-time basis in 2005, and processed about 1.2 million tons of high-ash coal purchased from several local coal operators. The DTE plant produces a solid synthetic product that is used to fuel cogeneration and traditional coal-fired power plants. A new air-sparge processing plant began operating in December 2005, and is still in start-up mode. The plant is owned by Covol Technologies, a subsidiary of Headwaters, Inc., and is rated at about 226 mt (250 st) per hour. The plant is located just south of the CV spur, and is scheduled to operate on a round-the-clock basis when fully operational.

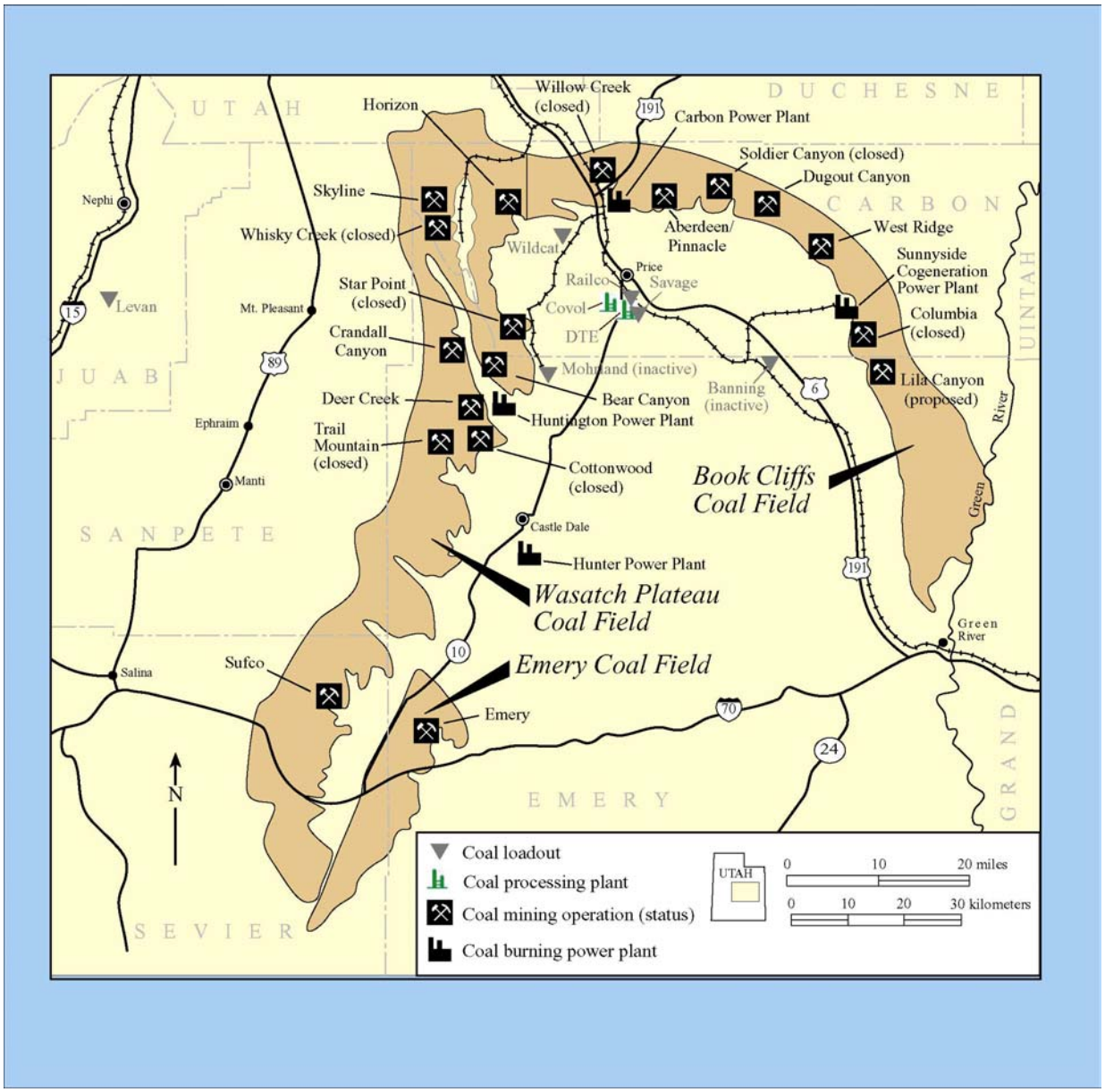

Figure 3. Location of coal mines and processing plants in central Utah.

The largest coal producer was the Sufco mine, operated by Canyon Fuel Company, LLC, which produced a near-record mine production high of 8.34 million mt (7.57 million st) of raw coal. In addition, the following three mines each produced in excess of 1.8 million mt (2.0 million st) of coal: (1) Deer Creek, operated by Energy West Mining Company (Pacificorp, Inc.);

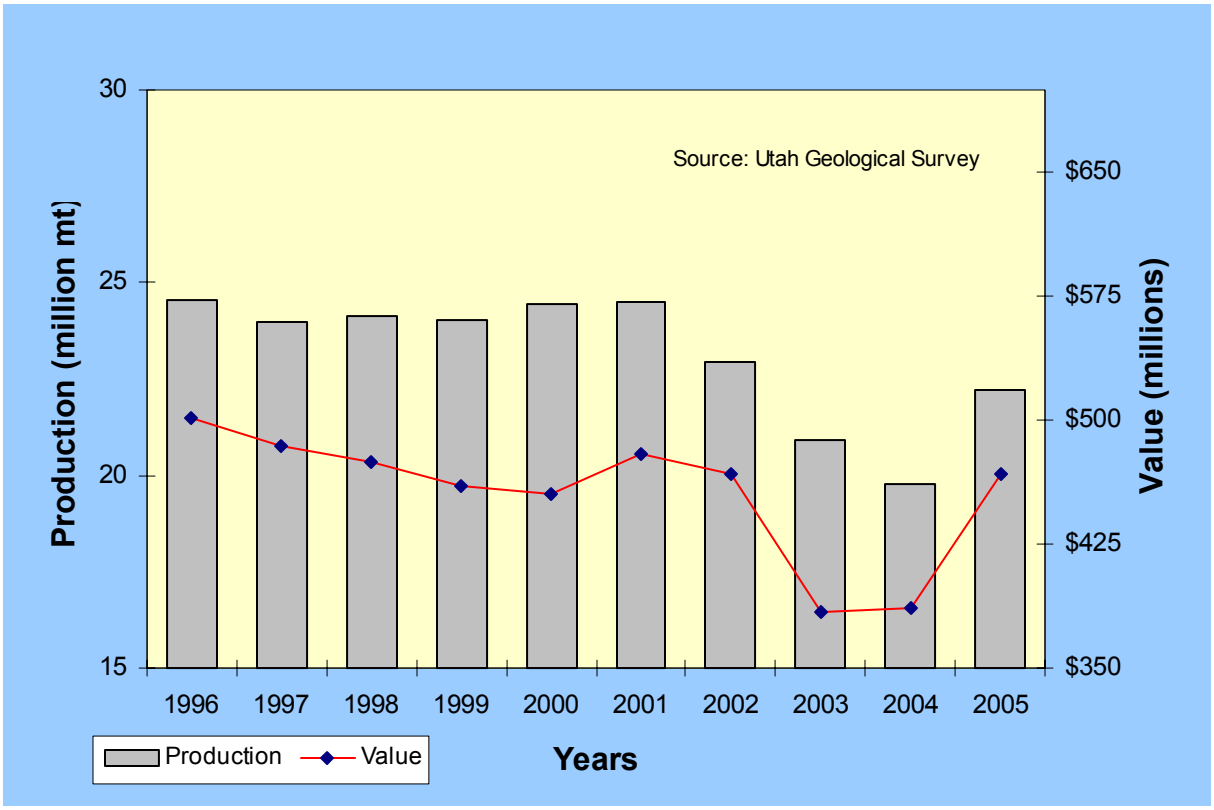

Figure 4. Utah's coal production and value from 1996 through 2005.

(2) Dugout Canyon, operated by Canyon Fuel Company, LLC and (3) West Ridge, operated by West Ridge Resources.

Three mines that had operated intermittently in the past, operated on a full time basis in 2005. These mines, in descending order of production were the Skyline, Emery, and Horizon (figure 3). One potential new mine (UtahAmerican Energy Company's Lila Canyon mine) is in the final stages of permitting and could begin producing within 18 months, depending on successful marketing. The surge in oil and gas prices that began in the fall of 2003 has had a positive effect on coal prices and production is anticipated to increase each year for the next several years. Most of Utah's coal was consumed in-state by three electric utilities in 2005.

EXPLORATION AND DEVELOPMENT ACTIVITY

Exploration increased in Utah during 2005 for copper, iron, molybdenum, gold, zinc, and uranium. Mine development work in Utah was performed on copper, copper-molybdenum, iron, and uranium projects. The number of new mining claims filed in the state has risen dramatically from a low of 508 in 2001 to over 7500 in 2005. San Juan County recorded the most new mining claims with more than 3400. The projects and mining districts discussed below are shown in figure 5.

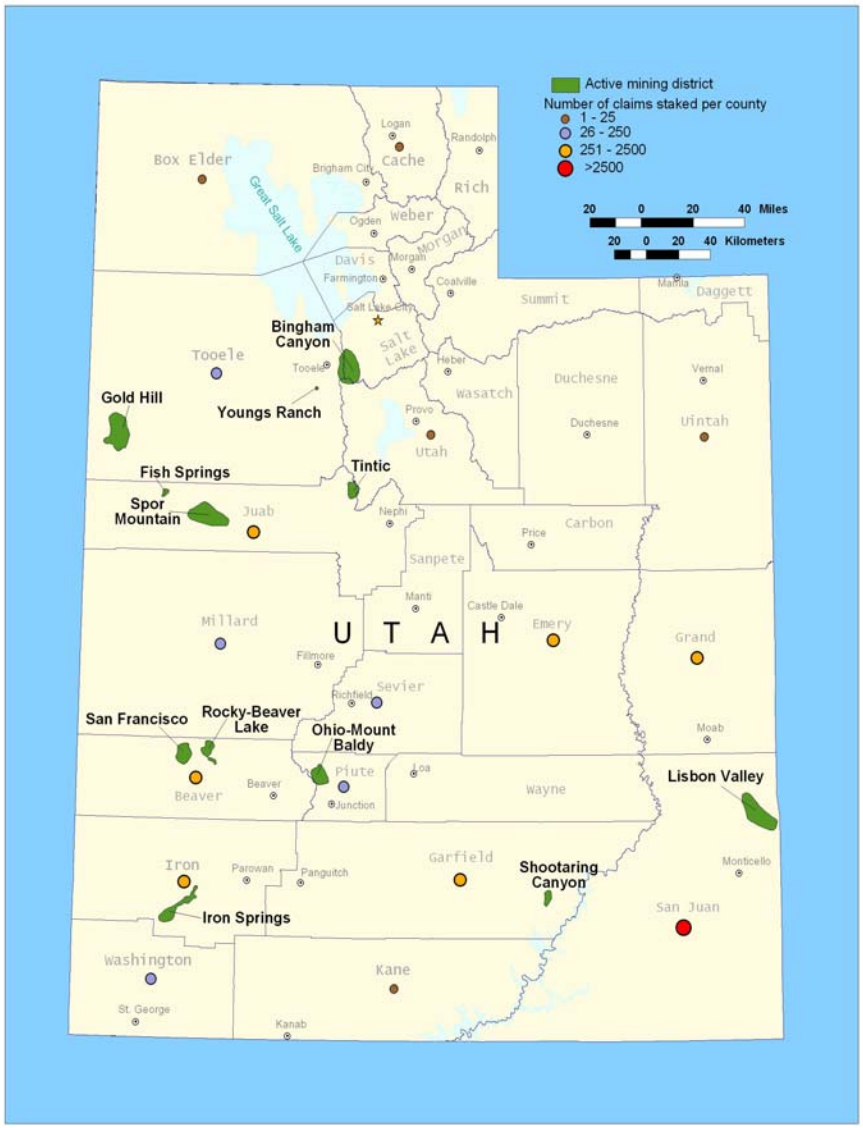

Figure 5. Major base- and precious-metals exploration areas in Utah during 2005.

Bingham District

Kennecott Utah Copper Corporation's development work at Bingham Canyon in 2005 included the approval of the $170 million East 1 pushback that will extend the open-pit mine life to 2017, and will fund an expansion of the molybdenum-recovery plant. The East 1 pushback adds about 147.8 million mt (163 million st) averaging 0.83% Cu, 0.10% Mo, 0.27 ppm Au, and 2.7 ppm Ag to the existing porphyry reserve. KUC also drilled nine deep exploration holes in 2005, totaling 9898 m (32,474 ft). KUC continues to evaluate various plans to exploit the deep porphyry roots beneath the ultimate pit. Options being studied include: (1) a west side (Highland Boy) open-pit pushback; (2) a North Skarn underground mine with a resource of 12.2 million mt (13.5 million st) averaging 1.9% Cu, 1.23 ppm Au, and 13.4 ppm Ag; and (3) a large block-cave

underground mine to develop the Northeast and Southeast porphyry roots. A recent photo of the Bingham pit is shown in figure 6.

As part of an ongoing porphyry copper exploration program, Kennecott Exploration Company drilled an aeromagnetic high (Youngs Ranch) in the pediment on the west flank of the Oquirrh Mountains about 22.5 km (14 mi) southwest of Bingham. The hole intersected 425 m (1394 ft) of alluvium and consolidated gravels before encountering unaltered, magnetic, andesitic agglomerate, massive porphyritic latite flows, and heterolithic tuffs cut by monzonite and latite porphyry dikes to a total depth at 919 m (3014 ft). The property was dropped and no further work is planned (W.L. Gunter, Consultant, verbal communication, 2006).

Figure 6. Kennecott Utah Copper Corporation's Bingham Canyon Cu-Mo-Au-Ag mine, Salt Lake County, Utah.

Lisbon Valley

Constellation Copper Corporation has started mining, crushing, stacking, and acid treatment at its Lisbon Valley solvent extraction – electro-winning (SX-EW) copper mine in southeastern Utah. Figure 7 shows the initial open pit (Sentinel) and facilities for the Lisbon Valley mine. The Lisbon Valley project is focused on sandstone-hosted, "oxide" copper. The 2005 year end reserves are estimated at 35.5 million mt (39.1 million st) averaging 0.49% Cu in three previously mined open-pits (Constellation Copper Company, 2006). The project is expected to produce about 24,500 mt (27,000 st) of cathode copper per year over the life of the mine. As with most recent development projects in the U.S., construction of the Lisbon Valley

SX-EW facility has been hampered by competition for supplies and labor with the rebuilding efforts resulting from hurricanes Katrina and Rita on the Gulf Coast. Mining at a rate of 21,800 mt/d (24,000 st/d), crushing, and placement of ore on pads is already underway. Copper cathode production is anticipated to begin in early 2006. Exploration continues at the new Flying Diamond copper discovery, on trend several kilometers to the southeast of the current operation. Initial drilling at Flying Diamond intersected an average 25.3 m (83 ft) of 0.71% Cu in 13 holes.

Figure 7. Constellation Copper Company's new Lisbon Valley copper mine and SX-EW plant, San Juan County, Utah.

Iron Springs

Palladon Ventures Ltd. acquired the Comstock-Mountain Lion open pit (about 16 million mt [18 million st] averaging 52% Fe) and Rex iron ore deposit in Iron County from the former Geneva Steel for $10 million. Iron Springs is the most productive iron district in the Western U.S., having produced an estimated 91 million mt (100 million st) averaging slightly over 50% iron from several skarn/replacement ore bodies from 1845 through 1995. Palladon bought out their joint-venture (JV) partner's (Western Utah Copper Company) interest in the property, selected a local mining contractor, posted a reclamation bond, started construction, and announced a contract to sell one million mt (1.1 million st) of ore to a Chinese purchaser. Palladon has further agreed to project financing terms with their new 50% JV partner, Luxor Capital Partners, LLP, for an open-pit mine and mill with expected capital costs of about $16 million (Don Foot, Palladon Ventures, verbal communication, January 19, 2006).

Milford Area

The Palladon Venture Ltd./Western Utah Copper Company (50-50) joint venture released a resource estimate on their Nevada Star copper property near Milford. This work shows a combined indicated resource from four separate skarn and porphyry deposits totaling 2.2 million mt (2.4 million st) and averaging about 1.38% Cu at a 0.6% Cu cutoff in the Rocky Range and Beaver Lake mining districts. The JV also released results from an exploration drill hole (BCC-1) near the Beaver Carbonate lead-silver mine in the San Francisco district. This hole cut 5 m (16.4 ft) of 3.7% Cu and 843 ppm Ag at a depth of 218 m (715 ft). The JV has applied for a Large Mine permit with the state.

Nevada Pacific Gold Company acquired the Bat Ridge gold-copper skarn prospect in the Beaver Lake mining district in 2005. Nevada Pacific completed a program of geologic mapping, rock-chip geochemical sampling, and an 860 line-km (540 line-mi), low-altitude, air-borne, aeromagnetic survey over the prospect. Additional work leading to a drill program is anticipated in 2006.

Tintic District

The Dragon halloysite clay mine in Juab County has been purchased for $500,000 by Atlas Mining Company of Osburn, Idaho. Halloysite is a high-value, bright white, microtubular, clay with unique applications based on its unusual structure. The deposit is a selective hydrothermal replacement of the Cambrian Ajax Limestone adjacent to a monzonite plug. Atlas is developing the 272,000 mt (300,000 st) deposit as an underground mine and is driving both an adit and -15° decline to access the halloysite beds. The majority of the higher grade material is below the 91 m (300-ft) level and the decline is currently at the 76-m (250-ft) level.

Ohio-Mount Baldy District

Unico, Inc. drilled 13 holes totaling over 2135 m (7000 ft) in 2005 at the Deer Trail mine in Piute County. The main objective was to identify and evaluate the mineralization contained in extensions of known base metal mantos in the Pennsylvanian Callville Limestone, which historically have averaged 6.5 ppm Au, 538 ppm Ag, 2.84% Pb, 6.26% Zn, and 0.76% Cu. Mineralization similar to that in the old, underground workings was intercepted in the drill holes. Unico was granted a Large Mine permit by the state.

Gold Hill District

Dumont Nickel cut greater than 3 m (10 ft) of 1 ppm gold in four of 24 holes it drilled on its Cane Springs property in Tooele County. The best hole (RC-20) includes 6 m (20 ft) from 4.6 m to 10.7 m (15 to 35 ft) averaging 9.6 ppm Au near the historic Cane Springs skarn gold mine. Dumont also intersected 54.9 m (180 ft) of 1.1 ppm Au in the nearby Kiewit zone (KZ-01), starting at the surface in an intense quartz vein stockwork hosted by granodiorite. Exploration drilling will continue in 2006.

Fish Springs District

Lithic Resources Ltd. acquired Euro Zinc's 100% interest in the Crypto zinc skarn in the Fish Springs mining district of western Juab County. In 1993, Cyprus Amax Minerals Company estimated a mineral resource of about 5.4 million mt (6 million st) of sulfide mineralization grading 8.7% zinc and approximately 2.8 million mt (3.1 million st) of oxide zinc mineralization grading 7% zinc.

Uranium

Escalating uranium prices rejuvenated exploration in the historic mining areas of the Colorado Plateau. In Utah, this work has primarily focused on areas of previously delineated but unmined resources. These areas have seen renewed claim staking and leasing of state-owned land.

Although uranium prices have increased significantly since December 2002 (rising from $22.44/kg [$10.20/lb] at the end of 2002 to $80.30/kg [$36.50/lb] at the end of 2005) (TradeTech, 2006), no uranium ore was mined in Utah in 2005. Eleven of 12 permitted uranium/vanadium mines were listed as inactive in 2004. One new Small Mine permit application was received in 2005, and seven NOIs were received for uranium exploration.

A uranium staking rush in the Four Corners region since the beginning of 2005 has resulted in the location of over 5000 new unpatented claims in San Juan, Emery, Grand, and Garfield Counties. Most of these new claims cover either known sandstone-hosted uranium resources or exploration plays in the major historical uranium districts. The Tony M and Frank M uranium reserves in the Shootaring Canyon district (Garfield County) are controlled by International Uranium Corporation and Energy Metals Corporation, respectively. Energy Metals has also acquired the nearby Congress uranium property.

The Lisbon Valley mining district, Utah's largest producer with 35.4 million kg (77.9 million lbs) of U_3O_8 recovered from approximately 11.6 million mt (12.8 million st) of ore, has been particularly heavily targeted by Universal Uranium Ltd. and Mesa Uranium Corporation. Energy Metals Corporation is also active in the district. Both the Shootaring Canyon and Lisbon Valley mining districts are located near existing, permitted uranium mills: Shootaring Canyon at Ticaboo (U.S. Energy Corporation, on standby) and White Mesa mill at Blanding (International Uranium Corporation, active).

Max Resource Corp. acquired 195 lode claims on a potential in-situ leach uranium play in the Spor Mountain district of west-central Utah. The mineralization is hosted in late Tertiary caldera-fill volcaniclastic rocks, similar to the nearby Yellow Chief uranium deposit. Max Resource Corp. has also received a permit for a six-hole, 366-m (1200-ft) drill program.

The U.S. Department of Energy and the State of Utah have agreed to move the 10.7 million mt (11.8 million st) of uranium mill tailings along the Colorado River near Moab. The tailings will be moved 48 km (30 mi) north to a site near Crescent Junction.

MINERALS INFORMATION

The UGS published a "Uranium and vanadium in Utah" digital map (Gloyn and others, 2005) that shows Utah's uranium-vanadium occurrences, mines, mining districts, mills, and the

distribution of the primary host strata. The UGS also completed studies on the "High-calcium limestone resources of Utah" as Special Studies 116 (Tripp, 2005), the coal resources of the southern Wasatch Plateau as Special Studies 114 (Quick and others, 2005), and "Large mines in Utah, 2005" as Open-File Report 468 (Bon and Wakefield, 2005).

The new "Uinta Mountains Geology" guidebook published by the Utah Geological Association (Dehler and others, 2005) contains two interesting papers on ore deposits. One paper discusses the many metal occurrences in the Uinta Mountains and a second paper covers the recently discovered Columbian-type, hydrothermal emerald and fibrous calcite mineralization along the South Flank fault zone. The guidebook also has papers on the Clay Basin gas field and the Ash Valley oil field.

A detailed summary of Utah's coal industry and other energy and mineral data can be found on the UGS' Web site <http://geology.utah.gov.>

REFERENCES

Bon, R.L., 2005, and Wakefield, S.I., 2005, Large mines in Utah, 2005: Utah Geological Survey Open-file report 468, map scale approximately 1:700,000.

Brush Wellman, 2006, Community News, Online, <http://www.brushelmore.com/>, accessed March 10, 2006.

Constellation Copper Company, 2006, Lisbon Valley Mine and Flying Diamond Exploration Update, Online, <http://constellationcopper.com,> accessed April 4, 2006.

Dehler, C.M., Pederson, J.L., Sprinkel, D.A., and Kowallis, B.J., 2005, Uinta Mountain Geology: Utah Geological Association guidebook 33, 448 p.

Energy Information Administration, 2006, Quarterly coal production by state, Online, <http://www.eia.doe.gov/cneaf/coal/quarterly/>, accessed March 16, 2006.

Gloyn, R.W., Bon, R.L., Wakefield, S.I, and Krahulec, K.A., 2005, Uranium and vanadium map of Utah: Utah Geological Survey Map 215DM, scale 1:750,000.

Kramer, D.A., 2006, Magnesium metal: U.S. Geological Survey Mineral Commodity Summaries, p. 104-105.

Magyar, M.J., 2006, Molybdenum: U.S. Geological Survey Mineral Commodity Summaries, p. 114-115.

Quick, J.C., Tabet, D.E., Hucka, B.P., and Wakefield, S.I., 2005, The available coal resource for nine 7.5-minute quadrangles in the southern Wasatch Plateau coalfield, Emery, Sanpete, and Sevier counties, Utah: Utah Geological Survey Special Study 114, 1 CD-ROM.

Rio Tinto, 2006, Rio Tinto 2005 annual report and financial statements, p. 49-51.

Shedd, K.B., 2006, Beryllium: U.S. Geological Survey Mineral Commodity Summaries, p. 34-35.

Tanner, Arnold, 2006, Utah-Unpublished preliminary data and production rankings: U.S. Geological Survey Mineral Industry Survey.

TradeTech, LLC, 2006, TradeTech's Uranium Exchange Value (Monthly Spot), Online, <http://www.uranium.info/prices/monthly.html>, accessed March 20, 2006.

Tripp, B.T., 2005, High-calcium limestone resources of Utah: Utah Geological Survey Special Studies 116, 60 p.

Willett, J.C., and Bolen, W.P., 2006, Crushed stone and sand and gravel in the fourth quarter of 2005: U.S. Geological Survey Mineral Industry Survey, 13 p.