

# 2004 Summary of Mineral Activity in Utah

R.L. Bon and Ken Krahulec, Utah Geological Survey

## SUMMARY

The value of Utah's mineral production (including coal) in 2004 is estimated to be \$2.32 billion, \$560 million (32%) higher than the revised value of \$1.77 billion for 2003. All major industry segments gained in value in 2004. Contributions from each of the segments were as follows: base metals, \$1.136 billion (49% of total); industrial minerals, \$643 million (28% of total); coal, \$387 million (16% of total); and precious metals, \$158 million (7% of total) (figure 1). Compared to 2003, the 2004 values of (1) base metals increased \$446 million (65%), (2) industrial minerals increased \$88.7 million (16%), (3) coal increased \$3 million (~1%), and (4) precious metals increased \$21.8 million (16%).

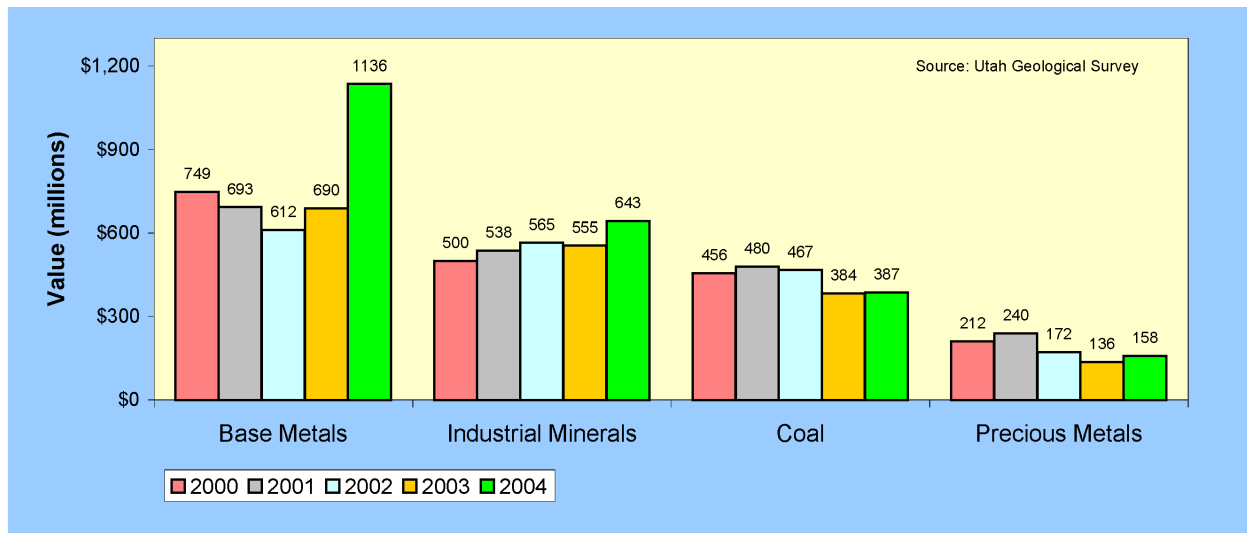


Figure 1. Value of Utah's mineral production from 2000 through 2004.

Nationally, Utah ranked 9<sup>th</sup> in the value of nonfuel minerals produced in 2003 (latest year that production figures are available) and accounted for about 3.4% of the total U.S. nonfuel mineral production value. Utah also ranked 13<sup>th</sup> in coal production in 2003. The state should retain similar or achieve higher national rankings in 2004.

The outlook for 2005 is optimistic. The value of mineral production is projected to increase again in 2005 due to increased production of all base and precious metals, coal, and most major industrial minerals. Base- and precious-metal prices increased significantly in 2003 and 2004 and should remain near or above their respective 2004 year-end prices during 2005. Industrial-mineral prices should also remain near their current levels as economic recovery continues, although a reduction in demand for several commodities is projected. Coal prices should increase as new coal contracts are negotiated at significantly higher rates.

During 2004, the Utah Division of Oil, Gas and Mining (DOG M) received 13 Large Mine permit applications (2 ha [5 acres] and larger disturbance) and 18 new Small Mine permit applications (less than 2 ha [5 acres] disturbance). The 13 Large Mine permit applications

include three new mine applications and 10 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 decreased in 2004 in spite of continued high metal prices. Fourteen Notices of Intent to explore on public lands were filed with DOGM in 2004, compared to 21 in 2003, 11 in 2002, and 14 in 2001.

The continued rebound in metal prices from the low point in 2002 has significantly increased activity in the metals mining sector. This activity started slowly, but in the last half of 2004, several developments were initiated that will both add to and prolong the longevity of Utah's metal mining sector. Two of the more important developments were the beginning of construction of Constellation Copper Company's Lisbon Valley copper mine and Kennecott Copper Company's announcement of a \$170 million expansion at the Bingham Canyon mine (Cu-Mo-Au-Ag) that added 147.7 million metric tons (mt) (162.9 million short tons [st]) of better-than-average grade Cu-Mo ore to the existing reserve.

## **OUTLOOK**

The value of mineral production in Utah is expected to increase modestly in 2005. Operator surveys indicate that base- and precious-metal, industrial-mineral, and coal values will all be higher. Base- and precious-metal production is forecast to increase as is coal. Industrial-mineral production is expected to be flat to slightly higher as many operators are operating at or near capacity. The opening of the Lisbon Valley base-metal mine in 2005 will add incrementally to the state's base-metal values. Precious-metal production will be slightly higher in 2005 due to increased production from Kennecott's Bingham Canyon mine, but will be partially offset by lower gold production from the company's Barney's Canyon mine. Industrial-mineral values will also increase because of continued higher demand for sand and gravel, crushed stone, cement, salt and brine-related products, and lime products. Coal prices are expected to increase as new contracts replace existing contracts at significantly higher rates. The recent upturn in metal prices should increase exploration for these metals over the next few years.

## **MINE PERMIT SUMMARY**

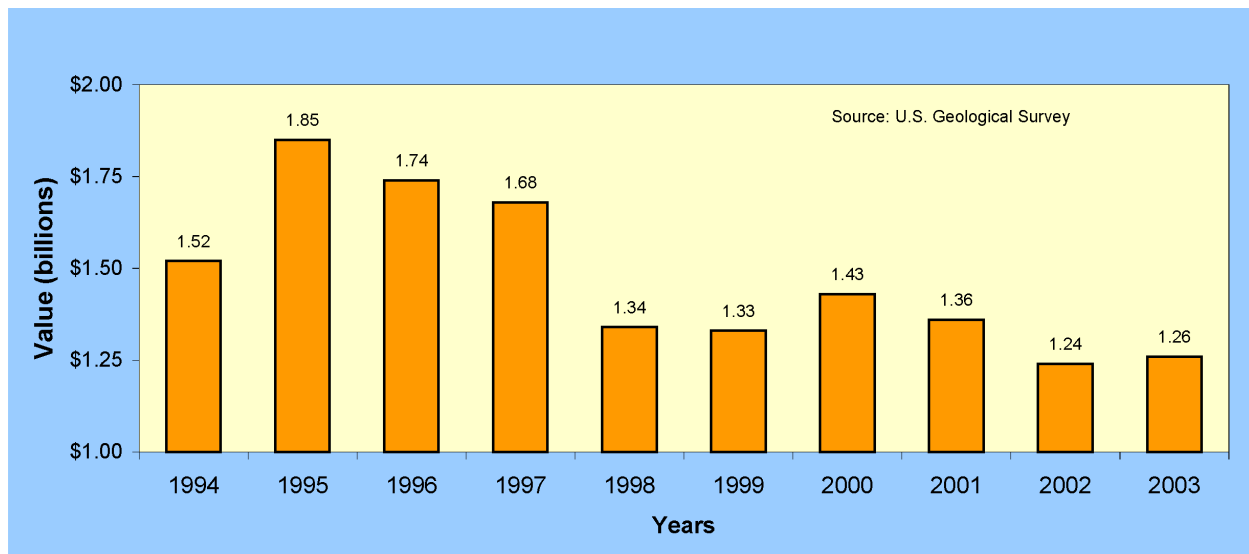
During 2004, DOGM received 13 Large Mine permit applications (2 ha [5 acres] and larger disturbance) and 18 new Small Mine permit applications (less than 2 ha [5 acres] disturbance). Nine of the Large Mine permit applications were for industrial minerals; three were for gems, geodes, fossils, or other, and one was for precious metals. Ten of the Large Mine permit applications were made to change from a Small Mine permit to a Large Mine permit, and three applications were for new mines. The 18 Small Mine permit applications include 14 industrial mineral; three gems, geodes, fossils, and other; and one precious-metal operations. The number of Large Mine permit applications was more than three times higher than in 2003 while the number of Small Mine permit applications was about the same.

Mine production reports for 2004 are still being filed with DOGM. In 2003, DOGM recorded production from 80 Large Mines (excluding sand and gravel), one fewer than in 2002. The Large Mines include four base-metal mines, three precious-metal mines, 13 coal mines, and 60 industrial-mineral mines (including gems, geodes, fossils, and other). The number of Large

Mines reporting production has been relatively consistent over the past five years. Eighty Small Mines reported production in 2003, 14 fewer than in 2002. These Small Mines included six precious-metal; one base-metal; 55 industrial-mineral; and 18 gems, geodes, fossils, and other operations.

### NATIONAL RANKINGS

The U.S. Geological Survey (USGS) ranked Utah 9<sup>th</sup> in the nation in the value of nonfuel mineral production in 2003 (latest year that production figures are available), compared to 11<sup>th</sup> in 2002. USGS data show that Utah accounted for 3.4% of the total U.S. nonfuel mineral production value in 2003. The 2003 data also show that Utah remained the only state that produced beryllium concentrates and magnesium metal. Additionally, Utah was second in the production of copper, magnesium compounds, and potash; third in gold and molybdenum concentrates; fourth in phosphate rock and silver; and sixth in salt. The state rose from fourth to third in perlite, and was a significant producer of common clays, construction sand and gravel, gemstones, lime, and Portland cement (Tanner, 2005). USGS data show that between 1994 and 2003 the value of nonfuel mineral production in Utah ranged from a low of \$1.24 billion in 2002 to a high of \$1.85 billion in 1995 (figure 2). The USGS’s preliminary estimate of the value of nonfuel mineral production for 2003 is \$1.26 billion, about \$20 million (less than 2%) higher than in 2002. The Utah Geological Survey's (UGS) estimate for the value of nonfuel mineral production for 2003 is \$1.38 billion, and \$1.94 billion for 2004.



**Figure 2. Value of Utah’s nonfuel mineral production from 1994 through 2003.**

### BASE- AND PRECIOUS-METAL PRODUCTION

Base-metal production, with an estimated value of \$1.136 billion, was the largest contributor to the value of minerals produced in 2004, an all-time high (figure 1). In descending order of value, those metals were copper, molybdenum, magnesium metal, and beryllium. The

2004 base-metal values were about \$446 million (65%) more than 2003. Precious-metal production, valued at \$158 million, included gold (85% of total value) and silver (15% of total value). Precious-metal values in 2004 were \$21.8 million (16%) more than in 2003.

Kennecott Utah Copper Corporation's Bingham Canyon mine, located about 32 km (20 mi) southwest of Salt Lake City in Salt Lake County, is the state's sole producer of copper and molybdenum, and the major producer of gold and silver. The combined value of minerals produced from the Bingham Canyon mine in 2004 was nearly one-half of the total value of all minerals produced statewide.

### **Copper**

Copper is the largest contributor to the value of nonfuel minerals in Utah. Substantial price increases in 2003 and 2004 raised the value of copper to near an all-time high, and the value of base-metal production statewide to over \$1 billion for only the second time. From 1995 through 2002, the price of copper fell significantly from \$3.04/kg (\$1.38/lb) in 1995 to \$1.67/kg (\$0.76/lb) in 2002. Copper prices rebounded in 2003 and 2004, closing the year 2004 at over \$3.30/kg (\$1.50/lb) and averaging \$3.00/kg (\$1.36/lb). Copper production from Kennecott's Bingham Canyon mine decreased slightly in 2004 to approximately 264,000 metric tons (mt) (291,000 short tons [st]) from 2003 production of approximately 282,000 mt (311,000 st) of copper metal. Kennecott also reports that the Bingham Canyon mine produces more than 10% of the annual refined copper requirements in the U.S. (Rio Tinto, 2005).

### **Molybdenum**

The sole molybdenum producer in Utah is Kennecott's Bingham Canyon mine, which produced about 6,800 mt (7,500 st) of by-product molybdenum in 2004, about 12% less than in 2003. The Bingham Canyon mine was one of only seven molybdenum-producing mines in the U.S. in 2004. The USGS reports that in the U.S., mine output of molybdenum increased 19% in 2004 (Magyar, 2005).

### **Magnesium Metal**

Magnesium metal was the third-largest contributor to the value of base metals in 2004. Magnesium metal is produced from Great Salt Lake brines by US Magnesium, LLC (formerly Magnesium Corporation of America [Magcorp]) at its electrolytic plant at Rowley in Tooele County (see figure 3). 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 was about the same as in 2003. In September, the company announced that it would increase annual plant capacity to 51,000 mt (57,000 st) through the addition of a third line of electrolytic cells (Platts Metals Week, 2004). The line will begin production in June 2005 and will be at full capacity in 2006. Magnesium metal prices reached a 12-year low in 2003, but have improved substantially over the past year.



**Figure 3. Location of brine processing plants around Great Salt Lake.**

### **Beryllium**

Utah continues to be the nation's sole producer of beryllium concentrates. Beryllium ore (bertrandite) is mined at Brush Resource's 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. In 2004, about 14,500 mt (16,000 st) of ore was mined and trucked to the processing plant. The mine produced substantially less ore than in previous years due to increased processing of stockpiled ore. The use of beryllium in electronic and electrical components, and aerospace and defense applications accounted for an estimated 80% of total consumption. Sales of alloy products increased during the first half of 2004 (Cunningham, 2005).

### **Gold and Silver**

Gold production in 2004 is estimated to be about 9,950 kg (320,000 Troy ounces [oz]), a 6% increase from the 9,300 kg (300,000 oz) produced in 2003. 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 Barney's 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 2006, when those pads will be depleted. The Bingham Canyon mine produced slightly more gold in 2004 than in 2003.

Silver is also a by-product metal from the Bingham Canyon mine. Silver production is estimated to be approximately 0.109 million kg (3.58 million oz) in 2004, about the same as in 2003.

## **INDUSTRIAL-MINERALS PRODUCTION**

Industrial-minerals production, with an estimated value of \$643 million, was the second-largest contributor to the value of minerals produced in 2004 (figure 1), an all-time high. The value of industrial minerals has grown substantially over the past five years, increasing from \$500 million in 2000 to \$643 million this past year, a 29% increase. Those commodities or commodity groups that have realized the majority of these gains include sand and gravel and crushed stone; Portland cement and lime; and salines, including salt, magnesium chloride, potash (potassium chloride), and sulfate of potash (SOP). These commodities account for about 90% of the total value of the industrial minerals segment. Other important commodities produced in Utah, in descending order of value, include phosphate, gilsonite, expanded shale, common clay, bentonite, and gypsum.

### **Sand and Gravel and Crushed Stone**

Sand and gravel, and crushed stone (including limestone and dolomite) were the highest contributors to the value of industrial minerals produced in Utah during 2004 (up from third-highest in 2003), with an estimated value of \$201 million, about \$61 million (44%) more than in 2003. 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 122 active sand and gravel pits and 20 stone quarries), the UGS did not send production questionnaires to this group. However, production data are compiled by the USGS. Based on third quarter USGS 2004 production data (Tepordei and Bolen, 2004), the UGS estimates that 2004 production will be 33.2 million mt (36.5 million st) of sand and gravel with a value of \$154 million, and 9.5 million mt (10.5 million st) of crushed stone with a value of \$47 million. Crushed stone production includes raw material for both lime and cement plants. This is a 27% increase in sand and gravel production and a 24% increase in the production of crushed stone compared to 2003.

### **Portland Cement and Lime**

Portland cement and lime were the second-highest contributors (down from first in 2003) to the value of industrial minerals produced in 2004, with a combined value of \$180 million, about \$13 million (8%) more than in 2003. Two operators produce Portland cement in Utah:

Holcim, Inc. (formerly Holnam, 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 capacity in 2004, with total production of nearly 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 12% higher in 2004 than in 2003, with an estimated production of about 660,000 mt (730,000 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. (formerly Continental Lime Company), 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. An additional 13 to 15 operators quarried about 2.0 million mt (2.2 million st) of limestone and dolomite in 2004, 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

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

Brine-derived products, including salt, were the third-highest contributors (down from second-highest in 2003) to the value of industrial-mineral production in Utah during 2004, with a combined value of \$179 million, about \$24 million (15%) more than in 2003. In addition to salt, brine-derived products include magnesium chloride and potash (potassium chloride and 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 location of operators around Great Salt Lake is shown in figure 3. The statewide production of salt and other brine-derived products, excluding magnesium metal, is estimated to be 3.44 million mt (3.78 million st) in 2004, about the same as in 2003. Potash production (including SOP) is estimated to be about 450,000 mt (495,000 st) in 2004, approximately 86,000 mt (95,000 st) more than in 2003.

Salt production alone is estimated to be 2.69 million mt (2.97 million st) in 2004, about 200,000 mt (220,000 st) more than in 2003, 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).

## **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 2004, the mine produced about 3.5 million mt (3.9 million st) of ore, about 5% more than in 2003.

## **Gilsonite**

Gilsonite production for 2004 is estimated to be about 63,600 mt (70,000 st), about 11,800 mt (13,000 st) more than in 2003. 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 Company, produce lightweight "expanded" products from shale and perlite for use primarily in the construction and building industries. Combined production was about 290,000 mt (320,000 st) in 2004. Utelite manufactures "expanded shale" for use as a lightweight aggregate. Utelite's mine is east of the town of Wanship in Summit County. Basin Perlite manufactures "expanded perlite" that is used mainly in building construction products. The perlite mine is located north and west of the town of Milford in Beaver County.

## **Common Clay and Bentonite**

Nearly 282,000 mt (310,000 st) of common clay and approximately 100,000 mt (110,000 st) of bentonite were produced by eight companies in 2004, a 45% increase in common clay and a 64% increase in bentonite compared to 2003. Statewide, there were 27 mine permits held by clay operators in 2004. Many of these mines operate intermittently. In descending order of production, the three largest producers of common clay in 2004 were (1) Interstate Brick Company, (2) Interpace Industries, and (3) Ash Grove Cement Company. 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. Sufficient stockpiled material will preclude any additional clay mining by ECDC in the foreseeable future.



## Gypsum

Six companies produced about 380,000 mt (420,000 st) of gypsum in 2004, nearly 32,000 mt (35,000 st) more than in 2003. 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 operate only intermittently. Georgia Pacific shifted wallboard manufacturing to the company's Las Vegas, Nevada facility.

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 19.7 million mt (21.7 million st) of coal valued at \$387 million from 13 underground mines in 2004 (figures 1 and 4). This production was approximately 1.3 million mt (1.4 million st), or 6.5%, less than in 2003. All of the mines and facilities are located in east-central Utah. 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 railroad spur near the town of Wellington. The plant operated on a limited basis in 2004, but is scheduled to operate on a full-time basis for at least the next two years using low-Btu, high-ash coal purchased from several local coal operators.



Figure 4. Utah's coal production and value from 1995 through 2004.

The largest coal producer was the SUFCO mine, operated by Canyon Fuel Company, LLC, which produced a near-record high of 6.87 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.) (Emery County); (2) Dugout, operated by Canyon Fuel Company, LLC (Carbon County) and (3) West Ridge, operated by West Ridge Resources (Carbon County).

The Horizon mine, owned by Hidden Splendor Resources, produced a small amount of coal before being idled in late January 2002. The mine was re-opened in 2003 and produced without disruption in 2004. Consolidation Coal Company's Emery mine, which was idled in late 2003, restarted in the fall of 2004. One potentially new mine (Utah American Energy Company's Lila Canyon mine) is in the final stages of permitting and could begin producing within a year or so, depending on successful marketing. The Skyline #3 mine, owned by Canyon Fuel Company, closed in May 2004 because of significantly increased water handling costs and related operational expenses. The mine is scheduled to re-open in the first quarter of 2005. 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.

Over half of Utah's coal was consumed in-state by three electric utilities in 2004. Coal was also used for industrial purposes within the state and shipped to electric utilities and industrial users in other states. The export market to Pacific Rim countries, which had accounted for up to 5.0 million mt (5.5 million st) of production in 1996, dwindled to less than 0.45 million mt (0.5 million st) in 2002, and to none in 2003 and 2004, mainly due to foreign competition. No overseas coal exports are anticipated in the next several years.

## **Uranium**

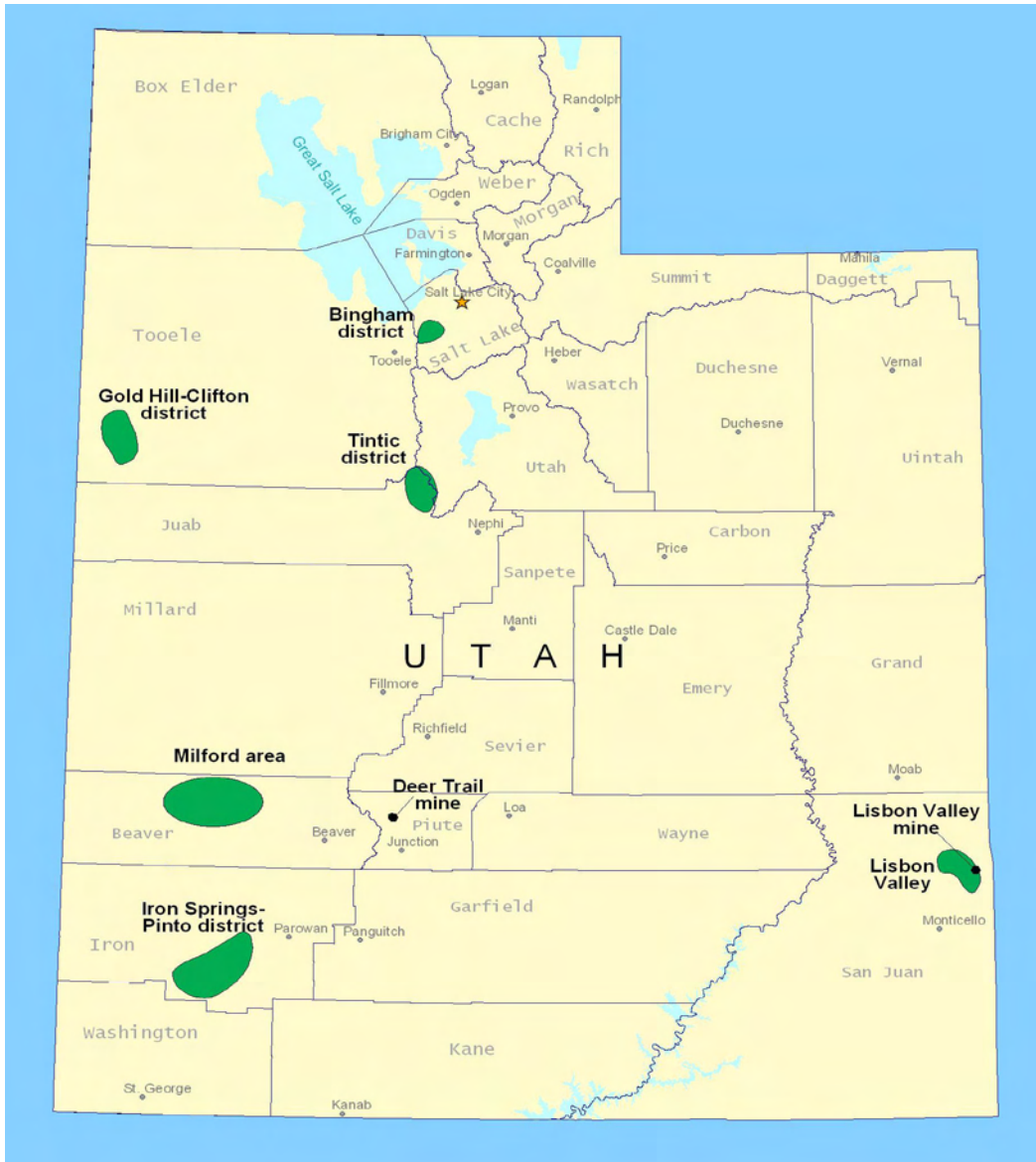
Escalating uranium prices rejuvenated exploration in the historic mining areas of the Colorado Plateau. In Utah, this work has primarily focused on areas of previously delineated but unmined resources, particularly in Emery, Garfield, Grand, and San Juan Counties. These areas have seen renewed claim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

Although uranium prices have increased significantly since July 2003 (rising from \$34.16/kg [\$15.50/lb] at the end of 2003 to \$45.62/kg [\$20.70/lb] at the end of 2004), no uranium ore was mined in Utah in 2004. U.S. Energy Company's Shootaring Canyon mill (Garfield County) remained idle the entire year while International Uranium Corporation's White Mesa mill (San Juan County) processed an "alternate feed." Eleven uranium/vanadium mines are listed as inactive statewide. Several uranium mines have re-opened in Colorado and at least one mine owner is contemplating re-opening one or more mines in Utah within the next year.

## **EXPLORATION AND DEVELOPMENT ACTIVITY**

Exploration in Utah began to turn around in the last half of 2004, lagging somewhat behind increasing metal prices (in U.S. dollars), and continued to improve into early 2005. More than 2900 claims were staked in Utah during the 2004 calendar year. Land acquisition for mineral exploration was particularly active in Iron (Fe and Au), San Juan (U and Cu), Beaver (Cu-Au), Washington (Au), Tooele (Au-Cu), and Emery (U) Counties.

DOG M received 14 new notices of intent (NOIs) for exploration, of which nine were approved. Of the 14 NOI applications, eight were for precious metals, four for industrial minerals, and two for base metals. The main metal exploration/development areas are discussed below and shown on figure 5. The Dragon halloysite property is included in this discussion because it is in a metal-mining district and owes its existence to hydrothermal alteration.



**Figure 5. Major base- and precious-metals exploration areas in Utah during 2004.**

### **Lisbon Valley**

The Lisbon Valley mining district in southeastern Utah was one of the most active exploration areas in the state in 2004. Companies actively acquired land in the district for both uranium and copper, and pursued copper exploration and (or) development. Constellation Copper Company’s Lisbon Valley project is the most advanced in the district.

Regionally, the Lisbon Valley copper project lies in the Pennsylvanian-Permian Paradox basin and is underlain by over 500 m (1640 ft) of salt in the Paradox Formation. Geologically, the Lisbon Valley area is dominated by a northwest-trending, doubly plunging anticline that is faulted along its northeast flank. This is a northwest-trending normal fault with roughly 300 m (1000 ft) of down-to-the-northeast throw. The Lisbon Valley mine area lies along the fault near the southeast end of the anticline. The Lisbon Valley district has copper-dominant ores to the northeast and uranium-dominant ores to the southwest. The typical copper ore body is hosted in bleached sandstone beds in the hanging wall of the fault. The copper-bearing minerals are malachite, azurite, and tenorite in the upper oxide zone, and chalcocite, bornite, chalcopyrite, cuprite, and bornite in the sulfide zone at depth.

Constellation is constructing an open-pit, heap-leach, solvent extraction-electrowinning (SX-EW) operation. Copper production should begin in September 2005, with full production by the end of the year. The three currently planned open pits are each typically 30 to 46 m (100-150 ft) deep with roughly a 0.1% copper cutoff grade. The Utah portion of the Lisbon Valley copper project has a seven-year mine life based on a reserve of 33.3 million mt (36.7 million st) averaging 0.51% copper. Capital costs are projected to be \$55 million with an annual cost of \$18 million in goods and services, \$10 million in taxes, and \$9 million in wages to the staff of 146. The projected cash costs are \$1.10/kg (\$0.50/lb) of copper with a total cost, including overhead, of \$1.65/kg (\$0.75/lb). The product will be 99.99% pure cathode copper. The Lisbon Valley project is targeted to produce 25,000 mt (54 million lbs) of copper per year (Washnock, 2005; Parkison and Thorson, 2005).

Initially, the mine will produce about 16,300 mt/day (18,000 st/day) of ore with a 2.25:1 stripping ratio. At full capacity, the mining rate will be 54,500 mt/day (60,000 st/day) of ore. The used processing plant was purchased and moved from the Hall porphyry, Mo-Cu mine near Tonopah, Nevada. In 2004, all of the facilities were relocated to a lay-down yard at Lisbon Valley. The general flow path from the mine is to the primary and secondary crusher, then to agglomerating with sulfuric acid to jump-start the leaching, and then to stackers to create the heap-leach pad. The pregnant liquor from the leach pad will then be pumped to the SX-EW facility for processing. The leach pads will be triple-lined and the acid will come from the Kennecott smelter near Salt Lake City. Tests show that the oxide ores are expected to leach in about 30 days, mixed ores (oxide-sulfide) in roughly 120 days, and sulfide ores in more than 150 days (Washnock, 2005; Parkison and Thorson, 2005).

Constellation has obtained all of the required permits from the state. The company also closed on a \$33 million financing package and made an initial deposit on four new Komatsu 730E haul trucks (186-mt [205-st] capacity), and one new Komatsu WA1200 wheel loader (34.3-cubic m [26.2-cubic yard] bucket capacity). Constellation commenced construction of the foundations for the crushing and SX-EW processing facilities in November 2004. Exploration is continuing for additional copper reserves, both in the mine area and along trend.

### **Bingham District**

Drilling at Kennecott's Bingham Canyon mine in 2004 focused on work designed to extend the mine life beyond about 2013. The thrust of this program was geotechnical drilling, infill resource-definition drilling in the pit, and mine dewatering. The geotechnical program was implemented by:

- Geological mapping and modeling for better geotechnical and operations support,

- Oriented core drilling for geotechnical planning efforts,
- Core drilling to collect strength data for pit slope stability analyses,
- Inclinometer drilling and construction for pit slope monitoring,
- Piezometer, water well, and horizontal drain drilling to monitor dewatering performance and assist with pit slope depressurization.

The economic and engineering study for a \$170 million pit expansion to the northeast was approved in February 2005. In addition to the pit expansion, Kennecott will purchase new equipment and build facilities, relocating some facilities, and expand operations at the Copperton concentrator. The new pit design added 147.7 million mt (162.9 million st) of better-than-average grade Cu-Mo ore which will extend mine life until 2017, and does not preclude future underground mining. Other mine options currently being considered are additional open-pit expansion, underground block caving, underground skarn mining, or any combination of the above. The targeting of deep porphyry and skarn mineralization is planned for 2005 (Rio Tinto, 2005).

### **Tintic District**

Atlas Mining Company is currently reopening the old Dragon halloysite mine in the southern portion of the Tintic mining district. Halloysite is an unusual, bright-white, microtubular, high-value clay used in specific ceramic, paint, and other potential applications based on its distinctive structure. The Dragon deposit is a selective hydrothermal replacement of portions of the Cambrian Ajax Limestone adjacent to a small monzonite porphyry plug. Atlas has driven a 91-m- (300-ft-) long, 15 degree decline into the halloysite deposit where they have drifted about 18 m (60 ft) using a small road header, installed a chain crusher (100% to -325 mesh), built an air classifier, and began test mining in late 2004. Atlas anticipates a mining rate of 900 to 1800 mt/month (1000-2000 st/month), based on market demand (William Jacobson, Atlas Mining Company, verbal communication, 2005).

### **Milford Area**

In late 2003, Palladon Ventures Ltd. (Palladon) optioned a 65% interest in Western Utah Copper Company's (WUCC) Milford area properties in the Rocky, Beaver Lake, San Francisco, and Blue Mountain areas in Beaver County. Palladon initiated an aggressive exploration program of drilling and geophysical surveys in 2004. In total, the company drilled 73 holes totaling more than 10 km (33,045 ft) on its 24,000 ha (60,000 acre) property. Drilling at the Maria open pit (three holes), Hidden Treasure mine (three holes), and Sunrise ore body (seven holes) confirmed previous mining grades. The best of these step-out holes is PMA-2 at Maria which cut 46 m (150 ft) of mineralization averaging 1.86% Cu with minor Au-Ag-Mo-W mineralization, and PSU-2 at Sunrise which intersected 53 m (175 ft) of mineralization running 1.81% Cu. Weak supergene chalcocite mineralization was intersected by drilling southwest of the OK mine (18 holes). Seven holes testing the Comet breccia pipe cut narrow intervals of Au-Cu mineralization (Dave Hartshorn, consultant, written communication, 2005).

The Palladon/WUCC Joint Venture completed Phase 1 of a two-phase program of detailed induced polarization (IP) and ground magnetic surveying. Phase 1 covered areas hosting known mineral resources to help define the geophysical expression of mineralization and

look for potential extensions of the currently defined resources. The geophysical program showed that significant IP chargeability, resistivity, and magnetic anomalies are associated with the known mineralization and provided some potential drill targets at depth. Phase 2 of the program, estimated to begin in early February 2005, will cover potential copper porphyry areas (Palladon Ventures Ltd., 2005).

### **Iron Springs-Pinto District**

Palladon (65% joint-venture ownership) and WUCC (35% joint-venture ownership) have entered into an agreement with Iron Ore Mines LLC to purchase its iron properties in the Iron Springs-Pinto mining district in southwestern Utah for \$10 million. Iron Ore Mines' property contains two iron deposits, the Comstock/Mountain Lion and the Rex. The Iron Springs-Pinto district has been one of the most productive iron ore districts in the western U.S. The bulk of the district's production occurred between 1923 and 1995, with its most productive period between 1947 and 1965 while being operated by U.S. Steel.

The Iron Ore Mines' property contains approximately 2000 ha (4940 acres) of patented mining claims and other fee lands and an additional 400 ha (990 acres) of unpatented mining claims. The measured reserve remaining in the Comstock/Mountain Lion pits is 25 million mt (27.6 million st) of ore averaging 47.1% Fe with a 0.3:1 stripping ratio. The Rex deposit, which has never been mined, contains a measured reserve of 80.9 million mt (89.2 million st) of ore averaging 39% iron, and could be amenable to open-pit mining. Near the Comstock/Mountain Lion deposit are several low-grade stockpiles estimated to contain a total of 12.5 million mt (13.8 million st) of ore averaging 42% iron. Palladon and WUCC are proposing to reopen the mine and construct an on-site smelter with a capital cost of \$1.1 billion (Wray, 2005).

### **Deer Trail Mine**

Unico, Inc. continued exploration to delineate Zn-Ag-Cu-Pb-Au resources in the Upper Deer Trail mine and the PTH Tunnel workings in the Marysvale district. Initial work consisted of surface, rock-chip sampling and underground confirmation sampling of old mine assays. A preliminary round of 28 reverse-circulation holes testing the Upper Deer Trail mine served to focus further work to the north and above the existing workings. Phase two drilling is designed to test known mineralized horizons in the PTH Tunnel area for new mineralization at depth. In addition to exploration work, significant improvements and additions were made to the mine's surface infrastructure (W.D. Proctor, Unico, Inc., written communication, 2005).

### **Gold Hill-Clifton District**

Dumont Nickel, Inc. has been exploring in the old Gold Hill (Clifton) mining district in western Tooele County for the past two years. Dumont is focusing on bulk-minable gold and gold-copper targets, and has assembled an 87-square-km (33 mi<sup>2</sup>) property position. The mineralization in the district is spatially related to a Jurassic, granodiorite pluton, which intrudes middle to upper Paleozoic carbonate and clastic sedimentary rocks. Production from the Gold Hill district includes Au, Ag, Cu, Pb, and Zn along with lesser amounts of W, As, Bi, and minor amounts of Sb, V, Sn, and Mo.

To date, Dumont's work has defined five project areas: (1) Kiewit (Au), (2) Cane Springs (Au), (3) IBA (Cu-Ag-Au), (4) Clifton Shears (Au-Ag-Pb-Zn), and (5) jasperoid silica-breccia (Au). Work in 2003 and 2004 included drilling 16 core holes totaling 2260 m (7413 ft), collecting 5200 soil samples over a 54-square-km (20 mi<sup>2</sup>) area, and taking 2500 rock samples over a 24-square-km (9 mi<sup>2</sup>) area. The most successful exploration work in 2004 occurred in the Kiewit area where the historic Kiewit Gold Zone of quartz stockwork was delineated in the granodiorite. This zone was tested by five holes totaling 465 m (1527 ft) of drilling. Two drill sites were chosen 60 m (197 ft) apart, and a fan of three holes was drilled from one site and two from the other. Each of the five holes cut from 6.6- to 43.7-m (21.6-143 ft) intervals of 1.0 g/mt (0.03 oz/st) Au or greater at shallow depths. Additional definition drilling is planned for 2005 (Dumont Nickel, Inc., 2005).

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