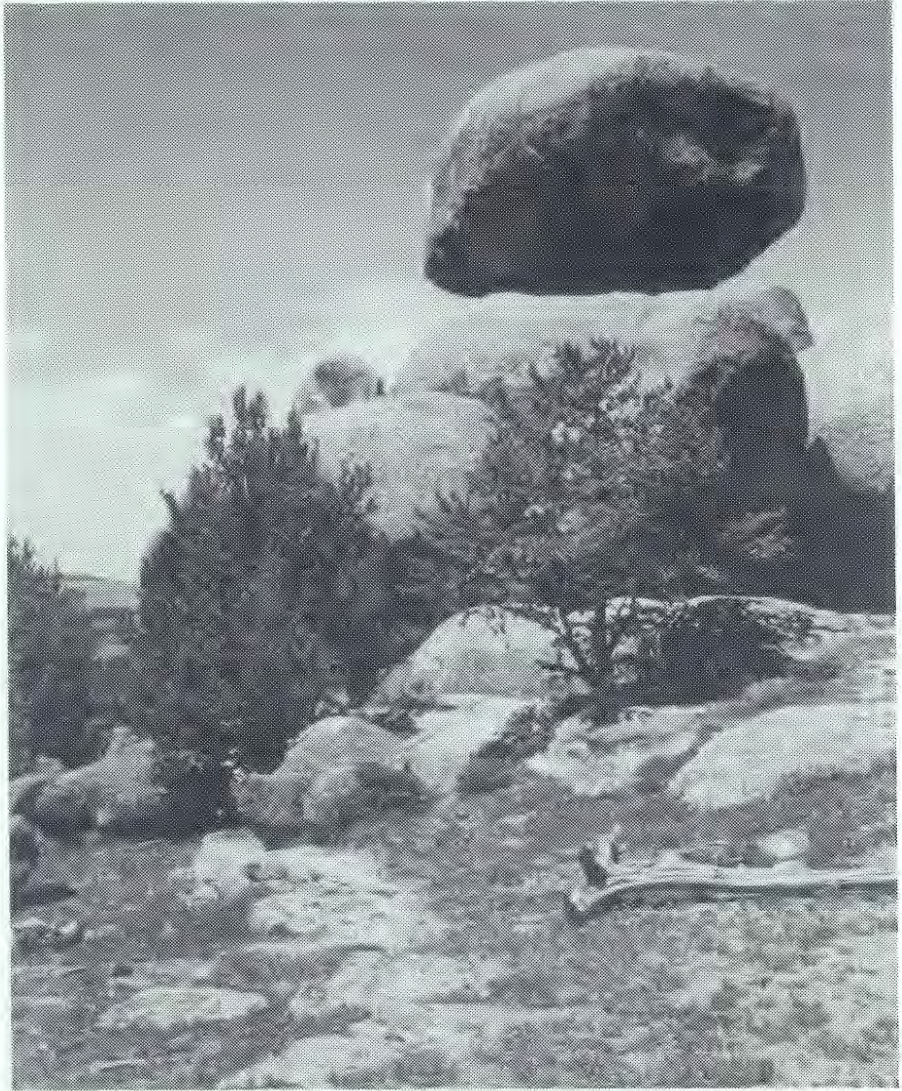


THE GEOLOGICAL SURVEY OF WYOMING
Gary B. Glass, State Geologist

WYOMING GEO-NOTES NO.19



LARAMIE, WYOMING

July, 1988

THE GEOLOGICAL SURVEY OF WYOMING

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WYOMING GEO-NOTES

This quarterly digest on the State's geology and mineral resources and activities of the Geological Survey is available by subscription (four issues for \$5.00) or as single copies at \$1.50 each.

Front cover: Balanced granite boulder in the Vedauwoo Glen area east of Laramie (photograph by Sheila Roberts). This area features spectacular, large, subrounded blocks of Precambrian Sherman Granite seemingly piled on top of one another. It is a favorite recreation and picnic destination and accessible off Interstate 80 between Laramie and Cheyenne. Vedauwoo Glen is described in more detail by D.L. Blackstone, Jr. in Bulletin 67, *Traveler's guide to the geology of Wyoming*. See page 34.

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Minerals update

OVERVIEW

by Gary B. Glass, State Geologist, Geological Survey of Wyoming.

In the second quarter of 1988, there is room for some cautious optimism for Wyoming's oil, gas, coal, and trona industries. Unfortunately, some earlier optimism for the State's uranium industry faded, but was not totally lost, by mid-year.

For the first-quarter of 1988, production of oil in Wyoming slightly exceeded the first three months of 1987, and we are now forecasting that 1988 production will end up close to last year's and not substantially decline. New production from the Moxa Arch (southwestern Wyoming) and the Powder River Basin, coupled with the success of an enhanced recovery operation in southcentral Wyoming, is apparently offsetting declining production from older fields at least for this year. Another three months of production statistics should help to firm up this prediction. Couple this healthier than expected production with some rather active leasing activity on both Federal and State tracts, and things look better than they have. The price of oil, however, continues to fluctuate and prices ended the second quarter down from the first quarter.

Natural gas production is increasing as forecast. In fact, it may show gains beyond what we have forecast in the table on page 2. Once production for the second three months of 1988 is available, refinement of our earlier forecast may be possible. Exxon's acquisition of a Montana oil field also opened the possibility that the market for its carbon dioxide reserves in southwestern Wyoming might increase.

Coal production for the first three months of 1988 has also started off exceeding last year's first quarter production, and if the current trend continues, we may have to revise our forecast of 147 million tons, higher.

As a follow-up to our earlier report on a test sale of Powder River Basin coal to Taiwan, it should be noted that the sale was in no small measure aided by the Burlington Northern Railroad (BN). BN has been quietly working with potential overseas users and domestic producers to achieve competitively priced shipments of coal to Pacific Rim countries. In fact, BN feels the sale of Mobil's coal to Taiwan was mostly due to Burlington's own efforts. The Pacific Rim market has been a target of some Wyoming producers for many years and with BN working to the same end, the possibilities of serving this market have substantially increased over what they had been in past years.

In regard to trona, the domestic market has picked up and boosted production during the first part of the year. This increase in domestic demand fortunately has offset some recent decreases in exports.

WYOMING MINERAL PRODUCTION FORECAST TO 1991¹

Calendar Year	Oil Production ²	Methane Production ³	Carbon Dioxide Production ³	Helium Production ⁴	Coal Production ⁵	Trona Production ⁵	Mined Uranium Production ⁶	In situ Uranium Production ⁷	Sulfur Production ⁸
*1981	122.1	455.4	--	--	102.8	11.8	4.6	--	0.05
*1982	118.7	465.1	--	--	107.9	10.1	2.1	--	0.07
*1983	120.9	539.7	--	--	112.2	10.5	3.0	--	0.57
*1984	127.8	600.1	--	--	130.7	11.0	1.6	--	0.63
*1985	131.0	597.9	--	--	140.4	10.8	0.6	--	0.80
*1986	122.4	563.2	23.8	0.15	136.3	13.3	0.3	--	0.66
*1987					146.5			0.5	
1987 ¹⁰	115.8	613.5	120.0	0.8		13.6	0.2 ⁹		1.0
1988	115.5	630.0	120.0	0.8	147.0	14.0	0.03	0.75	1.0
1989	117.0	665.0	120.0	0.8	148.0	14.1	0.03	0.75	1.0
1990	108.0	700.0	120.0	0.8	149.0	14.2	0.03	3.0	1.0
1991	100.4	730.0	120.0	0.8	152.0	14.3	0.03	3.0	1.0

*Actual values for comparison; ¹ Geological Survey of Wyoming, July, 1988; ² millions of barrels; ³ billions of cubic feet; ⁴ billions of cubic feet, based on Exxon's estimate that the average helium content in the gas processed at Shute Creek is 0.5 percent; ⁵ millions of tons; ⁶ millions of tons of uranium ore (not yellowcake); ⁷ millions of pounds of yellowcake (U₃O₈), (unknown between 1981-1986 because it was reported only as taxable valuation; estimates for 1987-1991 are based on company information); ⁸ millions of tons, converted from gallons of sulfur produced at gas processing plants as reported to the Wyoming Oil and Gas Conservation Commission; ⁹ includes previously stockpiled ore processed by the Lucky Mc mill in 1987; ¹⁰ 1987 values on this line are still preliminary.

If you are confused about what is happening to the uranium industry, you are not alone. Recently, U.S. District Judge James Carrington ordered the U.S. Department of Energy (DOE) to restrict its enrichment of foreign uranium that could be used in U.S. nuclear power plants. The restriction was to begin in January 1987 and continue until the domestic uranium mining industry was again viable. While a U.S. Appeals Court upheld the District Judge's decision, DOE's appeal to the U.S. Supreme Court has resulted in a decision that in essence overturns the District Judge and appeals court. Because of the Supreme Court's ruling, the uranium industry has gone back to the U.S. District Court in Colorado to prove that restrictions on enrichment of foreign uranium will help assure the viability of the domestic uranium industry. If this can be proven, DOE will have to restrict enrichment of foreign uranium. According to some observers, the short term future for domestic uranium mining in no small measure depends on the industry's success in this case and on the appeals that will probably follow any decision favorable to the industry. To this outsider, it looks like things have fortunately gone back to square one. In other words, what may have looked like the "end of game", is just a return to "start".

OIL AND GAS UPDATE

by Rodney H. De Bruin, Oil and Gas Division Head, Geological Survey of Wyoming

The average posted price for Wyoming Sweet crude oil was still on a roller coaster during the second quarter of 1988. The second quarter opened with posted prices for Wyoming Sweet in the \$16 per barrel range. Posted prices rose to an average of \$17.50 per barrel by the end of April and then started back down. By the end of June, the average posted price was \$15.50 per barrel. Most of the decrease in posted prices can be traced to a continuing glut of world crude oil supplies. At OPEC's June meeting, two main factions within OPEC continued to have widely different views on production strategy. One faction, led by Saudi Arabia and Kuwait, wanted to stimulate more demand for OPEC oil by raising production quotas so prices would stay at or below \$18 per barrel. The other faction, led by Iran, wanted to lower quotas so prices would increase above \$18 per barrel. The disagreement by these two main groups caused OPEC to extend their present production quotas until the next OPEC meeting. One complicating factor, which has the effect of raising production without exceeding quotas, is the practice by some OPEC members of selling more of their high gravity oil as condensate or natural gas liquids. Condensate and natural gas liquids are not included in present quotas.

The average price that Wyoming producers actually received for their oil from January through April was \$14.60 per barrel according to preliminary information from the U.S. Department of Energy.

Although fluctuating prices continue to plague oil and gas companies operating in Wyoming, there are several encouraging signs that the industry is on the rebound in the State. One barometer of future increased activity in the State is the success of the Federal and State lease sales held this year (see table on page 4). In the two U.S. Bureau of Land Management (BLM) sales held this year, 608,437 acres have been leased. This total is already more than 45,000 acres above the total acreage leased in BLM's 1985, 1986, and 1987 sales combined. In the first three State lease sales, 174,138 acres have been leased which is 76 percent of the total acreage offered. A much higher percentage of the total acreage offered at State sales has been leased so far this year than was leased in 1985, 1986, or 1987.

The high per-acre bid at the June BLM test sale held in Wyoming was \$575 by Exxon for a 917.11-acre parcel covering parts of sections 17, 18, 20, 21, and 28, T.33N., R.86W. This parcel is just west of Muddy Sandstone production at Sun Ranch Field in Natrona County. In all, 44 parcels received bids of \$100 or more per acre at this sale.

The high per-acre bid of \$290 at the Wyoming Department of Public Land's May sale was made by Anna Wells for a 160-acre lease in section 20, T.50N., R.71W. in Campbell County. The lease is two miles north of Minnelusa production from AG Farm Field, discovered in 1986. The two wells in AG Farm Field have already produced over 280,000 barrels

WYOMING FEDERAL AND STATE COMPETITIVE OIL AND GAS LEASE SALES

BLM SALES

Month	Total Revenue	Number of parcels offered	Number of parcels sold	Total acres	Acres sold	Average price per acre sold	High price per acre
1985							
February	\$ 3,547,273	117	115	34,948	34,028	\$ 104.24	\$ 1,700.00
April	2,025,793	133	128	25,497	24,056	84.21	2,609.53
June	1,963,897	140	137	40,304	38,904	50.48	2,577.15
August	2,854,821	190	146	75,094	56,906	50.17	1,732.14
October	1,876,105	208	105	81,611	32,052	58.53	1,108.77
December	1,467,265	211	144	73,723	46,908	31.28	1,167.23
TOTAL	\$13,735,154	999	772	331,177	232,854	\$ 58.99	\$ 2,609.53
1986							
February	\$ 1,992,326	211	154	58,507	38,809	\$ 51.34	\$ 680.00
April	1,795,890	189	116	54,136	29,938	59.99	1,881.88
June	1,332,216	86	75	27,137	24,512	54.35	437.50
August	529,184	104	88	25,686	22,725	23.29	227.63
October	840,950	76	68	17,827	16,604	50.65	516.86
December	774,824	110	82	28,057	19,840	39.05	3,313.13
TOTAL	\$ 7,265,390	776	583	211,350	152,428	\$ 47.66	\$ 3,313.13
1987							
February	\$ 814,653	78	64	18,866	15,537	\$ 52.43	\$ 1,226.56
April	779,821	95	68	23,338	16,214	48.10	332.00
June	6,436,196	123	121	26,188	25,668	250.75	6,555.00
August	1,327,186	81	74	22,908	21,055	63.03	800.01
October	3,274,611	137	129	34,858	33,828	96.80	6,031.15
December	3,091,692	213	190	71,264	65,658	47.09	521.00
TOTAL	\$15,724,159	727	646	197,422	177,960	\$ 88.36	\$ 6,555.00
1988							
March	\$ 7,338,210	866	336	1,073,940	315,387	\$ 23.27	\$ 525.00
June	7,564,135	820	375	755,242	293,050	25.81	575.00

STATE SALES

Month	Total Revenue	Number of parcels offered	Number of parcels sold	Total acres	Acres sold	Average price per acre sold	High price per acre
1985							
January	\$ 757,214	200	86	80,019	27,520	\$ 26.51	\$ 1,700.00
March	2,077,478	300	172	137,321	69,781	29.77	1,600.00
May	936,374	199	117	73,625	35,273	26.55	350.00
July	636,350	200	113	83,491	43,630	14.59	280.00
September	989,069	200	126	95,052	60,356	16.39	325.00
November	494,739	200	109	70,144	41,399	11.95	320.00
TOTAL	\$ 5,891,224	1,299	723	539,652	277,959	\$ 21.19	\$ 1,700.00
1986							
January	\$ 630,069	200	123	83,064	49,783	\$ 12.66	\$ 320.00
March	773,492	199	112	77,237	44,504	17.38	370.00
May	354,941	200	70	74,128	27,543	12.89	140.00
July	418,280	200	63	86,495	25,461	16.43	234.00
September	171,975	200	80	87,017	33,738	5.10	360.00
November	99,403	200	74	75,385	24,728	4.02	120.00
TOTAL	\$ 2,448,160	1,199	522	483,326	205,757	\$ 11.90	\$ 370.00
1987							
January	\$ 300,404	200	74	87,145	32,606	\$ 9.21	\$ 2,300.00
March	270,234	200	83	87,034	35,770	7.55	100.00
May	416,108	200	88	81,343	34,111	12.20	260.00
July	477,891	200	107	91,884	47,015	10.16	125.00
September	362,903	200	100	82,367	44,698	8.12	210.00
November	699,027	200	127	81,865	50,540	13.83	290.00
TOTAL	\$ 2,526,567	1,200	579	511,638	244,740	\$ 10.32	\$ 2,300.00
1988							
January	\$ 826,698	200	142	76,953	56,430	\$ 14.65	\$ 200.00
March	800,213	200	133	76,304	48,423	16.53	465.00
May	1,649,974	200	182	75,987	69,285	23.81	290.00

Sources: Wyoming Department of Public Lands, Petroleum Information Corporation - Rocky Mountain Region Report, and U.S. Bureau of Land Management.

of oil. Thirteen leases in this sale, all in the Powder River Basin, received bids of \$100 or more per acre.

There were 442 well completions in Wyoming through the middle of June compared to 349 for the same period last year (Petroleum Information, 1988). Wyoming should have over 1,000 well completions in 1988 compared to 800 in 1987. So far in 1988, 36 exploratory wells have been completed as oil or gas discoveries compared to 64 for all of 1987. In addition, 20.5 percent of the exploratory wells have been successful in the first half of this year (Petroleum Information, 1988). If this trend continues, 1988 will be the best year since 1982 in terms of the success ratio for exploration wells.

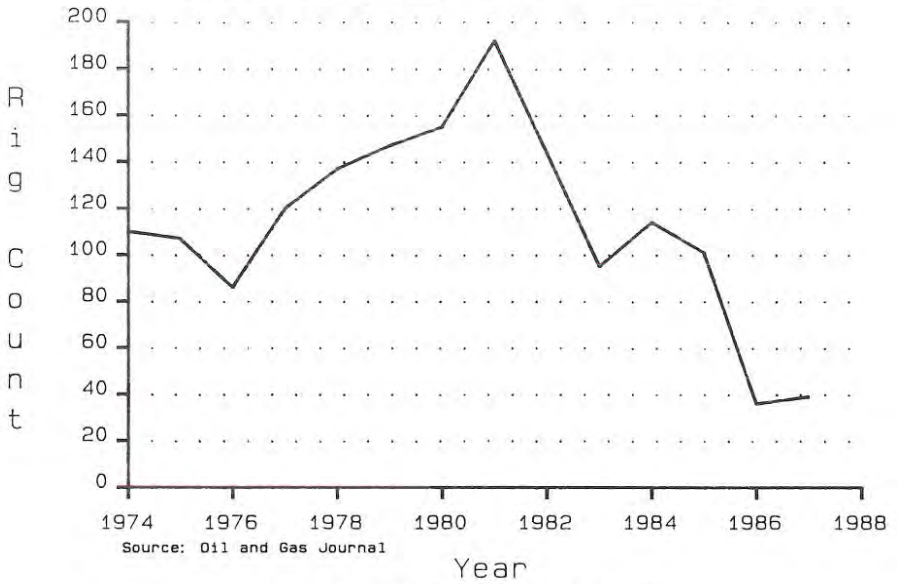
Wyoming's average monthly rig count, although not dramatically higher than for the first six months of 1987, has improved somewhat. The count should improve for the last half of the year if the trend follows that for past years (see graphs on page 6 and 7). By July 6th, the count had reached 50.

According to preliminary production statistics from the Wyoming Oil and Gas Conservation Commission, oil production in the State for the first three months of 1988 is slightly ahead of the comparable period in 1987, and natural gas production is almost 15 billion cubic feet higher than in 1987. In early 1988, oil production did not decrease, as first expected, due to increased production at fields on the Moxa Arch (mainly Luckey Ditch, Swan, Lincoln Road, and Blue Forest), to continued success in and extension of the Minnelusa play in the Powder River Basin, and to better than expected production from infill drilling and enhanced recovery at Wertz Field. These factors offset declining production in most of the older fields. Increased gas production was mainly a function of increased demand because of colder than average weather the first three months of this year. Warmer than average temperatures in early summer should also keep production up due to demands related to air conditioning.

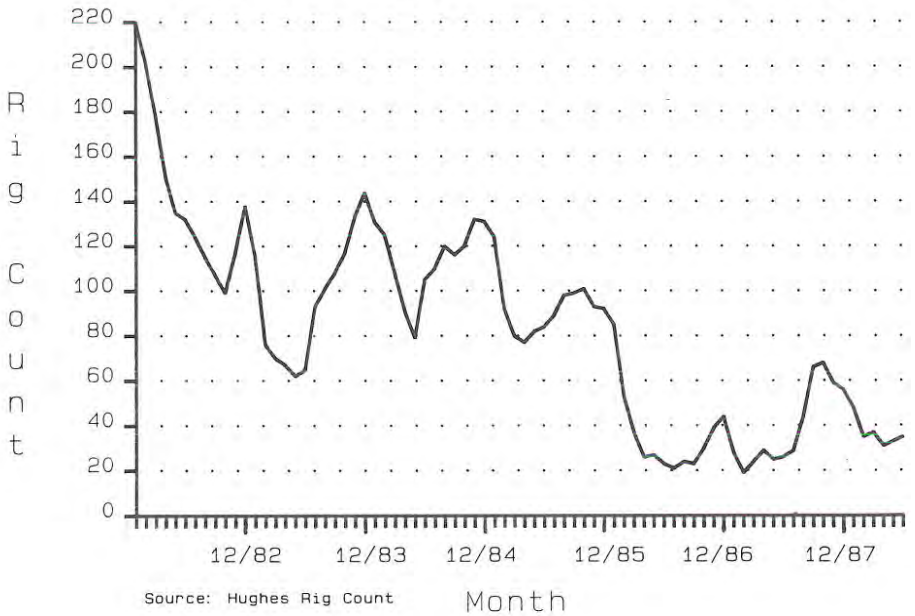
In a reversal of recent trends, Conoco has announced that it will increase its Casper exploration and production staff by 17 employees. The new employees, mainly geologists and engineers, will initially study Conoco's existing fields in the State to determine if any are suitable for enhanced oil recovery projects.

In an item related to enhanced oil recovery, Exxon has bought a controlling interest in Bell Creek Field located in the Montana portion of the Powder River Basin. This purchase may well be the first step in a series of events that could provide huge benefits to Wyoming's oil and gas industry. Because Bell Creek Field is a prime candidate for carbon dioxide (CO₂)-enhanced oil recovery, Exxon's purchase of this field could bode well for expanded usage of Exxon's CO₂ reserves in southwestern Wyoming. It is possible Exxon will move forward with earlier plans to construct a pipeline from the Wertz and Lost Soldier Field area to Tloga, North Dakota, to carry CO₂ for enhanced oil recovery projects in the Powder River and Williston Basins. The completion of this pipeline would mean that oil producers

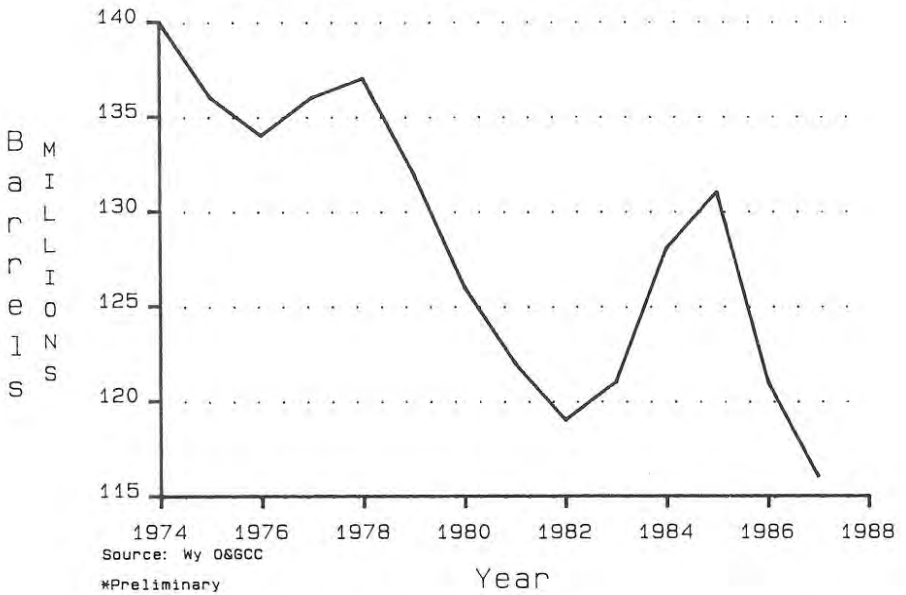
WYOMING RIG COUNT
 AVERAGED BY YEAR (1974 TO 1987)



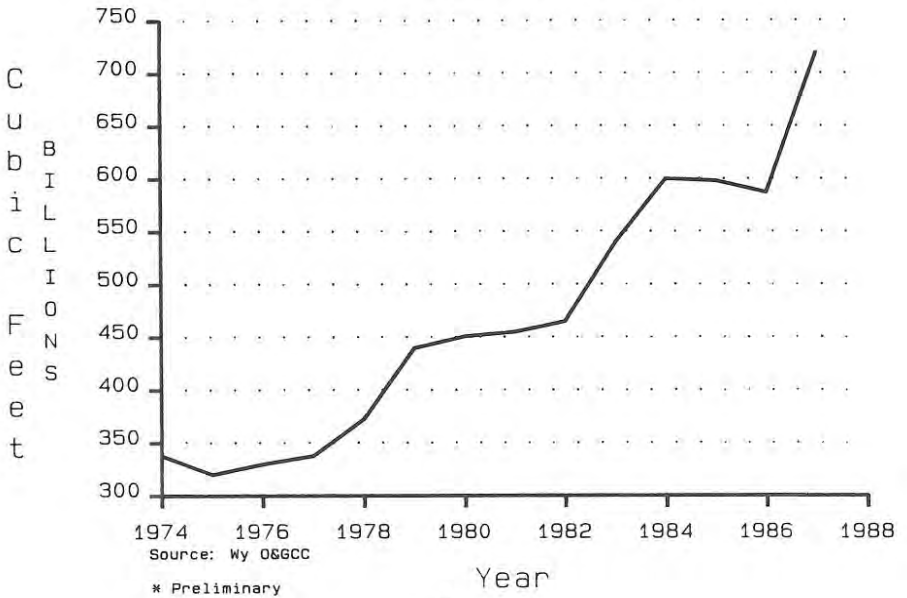
WYOMING RIG COUNT
 AVERAGED BY MONTH (1982 TO PRESENT)



WYOMING OIL PRODUCTION
BY YEAR (1974 TO 1987*)



WYOMING NATURAL GAS PRODUCTION
BY YEAR (1974 TO 1987*)



In Wyoming's Powder River Basin would have an abundant supply of CO₂ for enhanced oil projects. Many of the very large fields in that basin such as Salt Creek, Hartzog Draw, and Hillight as well as many other fields which produce oil from the Minnelusa Formation are considered likely candidates for CO₂ injection. If enough additional demand is generated for their CO₂, Exxon might even build Phase II of their Shute Creek gas processing facility.

Kern River Gas Transmission Company announced that it has signed letters of intent with several oil companies to deliver natural gas from southwestern Wyoming to southern California. So far the company has obtained commitments to deliver over 330 million cubic feet per day. Kern River plans to obtain commitments to ship 500 million cubic feet of gas per day. The company hopes that these commitments will show the Federal Energy Regulatory Commission that their application to build the pipeline should be approved. If Kern River's application is approved, the company expects to begin operations in 1991.

On June 29th more good news for Wyoming's petroleum industry was announced by the U.S. Environmental Protection Agency (EPA). The EPA will not regulate oil and gas drilling wastes as hazardous materials. The EPA estimated that oil and gas production would be cut up to 12 percent if drilling wastes were treated as hazardous. The cost of the program would have been between one and six billion dollars.

The U.S. Forest Service has blocked construction of a road to Amoco's proposed Sohare Creek well near Togwotee Pass because of an appeal filed by seven groups that claim the road would damage grizzly bear habitat. Amoco had planned to start construction this summer.

Wyoming's Attorney General issued an opinion which says that Wyoming can tax helium production on Federal land unless the Federal government specifically gives a producer immunity from State taxation. Exxon is currently the only producer of helium in Wyoming. The Director of the State's Department of Revenue and Taxation cited figures from Exxon which showed nearly \$4 million in gross revenue from helium sales during the last three months of 1986 and nearly \$37 million in gross revenue from helium sales for all of 1987.

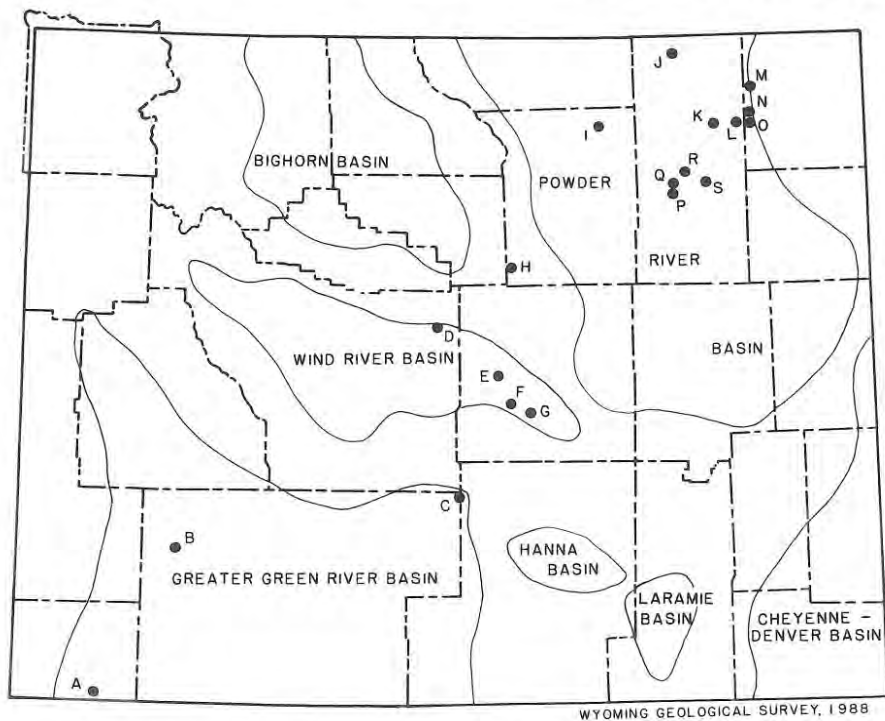
In a related item, Exxon has filed a suit against the State concerning a law passed in the 1988 Legislative Session. This law limits deductions taken in calculating severance and ad valorem taxes on natural gas to 40 percent of the sales revenue from processed gas. Exxon claims the law is unconstitutional under nine provisions of the Wyoming Constitution and under two provisions of the U.S. Constitution. Since 1986, Exxon has paid no taxes on gas produced for processing at their Shute Creek plant because total deductions calculated by Exxon resulted in a zero value for the wellhead gas.

Based on company data and information compiled and published by Petroleum Information, several significant exploration and development events occurred in Wyoming during the second quarter of 1988. The letters in the following discussions refer to locations on the figure on page 9.

A. Texaco completed a wildcat well in the Dakota sand in section 1, T.12N., R.115W. on the southern end of the Moxa Arch. The 1 TPI-Whiskey Springs Unit well was tested between 15,352 and 13,389 feet and flowed 1,268 barrels of 38.3° API gravity oil and 527,000 cubic feet of gas per day with no water. The well is just over two miles from the west edge of Luckey Ditch Field.

B. Sun Exploration and Production completed two gas discoveries on the Moxa Arch. The 1 Swan South-Federal in section 4, T.23N., R.110W. was completed in the Dakota sand flowing 1,246,000 cubic feet of gas and one barrel of 45.4° API gravity oil per day. The 2 Swan South-Federal-A in section 8, T.23N., R.110W. was completed in the Frontier Formation flowing 1.2 million cubic feet of gas, 0.5 barrels of condensate, and one barrel of water per day.

C. Three new Infill wells are adding to increased production at Wertz Field. Production at Wertz has already increased substantially due to a very successful enhanced oil recovery project using CO₂. Amoco Production completed the 148 ABC Unit well in section 7, T.26N., R.89W., flowing 1,234 barrels of oil and 3,018 barrels of water per day. The 147 Wertz ABC Unit well in the same section was completed pumping 573



OIL AND GAS EXPLORATION AND DEVELOPMENT ACTIVITY IN WYOMING

barrels of oil, 6,152,000 cubic feet of gas, and 227 barrels of water per day. The 150 Wertz ABC Unit well in section 12, T.26N., R.90W. was completed pumping 148 barrels of oil and 6,633 barrels of water per day. All three new wells are producing from the Tensleep Sandstone. Amoco has completion work under way at three other Tensleep wells in the field and has locations staked for two more Tensleep wells.

D. The BHP Petroleum 2-3 Bighorn well in section 3, T.38N., R.90W. flowed 38 million cubic feet of gas per day following acid treatment of the Madison Limestone between 23,579 and 23,852 feet. Gas is 69 percent methane, 20 percent carbon dioxide, and 11 percent hydrogen sulfide. This well confirmed the discovery made in 1985 when the 1-5 Bighorn well was completed in section 5, T.38N., R.90W., flowing 20 million cubic feet of gas per day from the Madison Limestone. BHP and its partners are developing plans for a gas treatment plant. There is a railroad near the 2-3 Bighorn well which could be used to ship sulfur removed by a treatment plant. The 2-3 Bighorn took 15 months to drill but reached total depth 100 days earlier than estimated. It took 200 days less than the 1-5 Bighorn to drill.

E. Standard Oil Production has reached total depth at its 2-20 Wild Horse Butte well in section 20, T.35N., R.87W. The well is a Muddy Sandstone test about one mile northwest of the company's Wild Horse Butte Field discovery in section 28, T.35N., R.87W. The discovery well was completed in 1985 flowing 3.7 million cubic feet of gas per day from the Muddy, but this well has never been put on production. Standard has also started drilling a 17,300-foot test to the Dakota in section 36, T.35N., R.87W. The test will evaluate the Frontier, Muddy, and Dakota.

F. Sun Exploration and Production started up a new gas plant to process natural gas from Sun Ranch Field. The plant has the capacity to process 5 million cubic feet of gas per day and to produce 12,500 gallons of product. The plant will initially process one million cubic feet of gas per day and produce 3,000 gallons of product.

G. The Muddy Sandstone play in the Wind River Basin continues to grow as Exxon and Tenneco recently completed a wildcat well in section 7, T.32N., R.84W. The discovery flowed 288 barrels of oil and 392,000 cubic feet of gas per day. Tenneco has staked a location for an offset well in the same section as the discovery well. Exxon also has plans for drilling an offset well but has not yet staked any locations. The new discovery is three miles from Muddy production at Grieve Field and 10 miles from Muddy production at Sun Ranch Field.

H. Woods Petroleum has discovered oil at their 25 Taylor Unit well in section 31, T.42N., R.76W. The well was completed in the Frontier Formation and flowed 111 barrels of 40° API gravity oil and 74 barrels of water per day. Woods has staked a location for another Frontier test in section 32, T.42N., R.76W.

I. Smokey Oil has an apparent oil discovery in section 35, T.52N., R.79W. A drill stem test in the Minnelusa yielded 1,400 feet of 34° API gravity free oil. The sample chamber held 2,675 cubic centimeters

of oil and 1.1 cubic feet of gas. Smokey Oil is a True Oil affiliate, and True is drilling an offset to the Smokey Oil well about a half mile to the south in section 2, T.51N., R.79. The nearest Minnelusa production is nearly 35 miles southeast at Lewis Field.

J. Marathon Oil completed a new discovery three miles south of the nearest Minnelusa production at Sandbar East Field. The 42-18 Big Ute well in section 18, T.52N., R.72W. was completed pumping 90 barrels of 19° API gravity oil and 167 barrels of water daily from the Minnelusa.

K. Nicor Exploration completed a Minnelusa wildcat in section 25, T.51N., R.70W., pumping 229 barrels of oil per day. The discovery is about one mile northwest of Pleasant Valley Field and one mile south of Marnie Field, both of which produce from the Minnelusa.

L. A new Minnelusa discovery, pumping 507 barrels of 24° API gravity oil per day, was completed by Terra Resources in section 10, T.51N., R.69W. The 13-10 Simpson well is one-half mile north of Minnelusa oil production at Simpson Ranch Field.

M. Morgan Richardson Operating completed a Muddy Sandstone discovery in section 29, T.54N., R.68W. pumping 189 barrels of oil per day. The well is two miles northeast of the nearest Muddy production at Prairie Creek Field.

N. A Minnelusa discovery by Decalta International in sec. 18, T.52N., R.68W. produced an average of 197 barrels of 20° API gravity oil per day in February and March according to State production records. The company has staked an east offset in the same section as the discovery well.

O. Donald Slawson completed a Minnelusa discovery, pumping 402 barrels of oil per day, in section 18, T.51N., R.68W. The discovery is a mile west of the nearest Minnelusa production at Miller Creek Field.

P. A wildcat drilled by Smokey Oil was completed, pumping 45 barrels of oil per day from the Upper Cretaceous Parkman. The discovery in section 26, T.48N., R.74W., is over two miles northeast of Parkman production at Sawmill Draw Field.

Q. Depco Incorporated opened a new Minnelusa oil field in section 35, T.48N., R.73W. with two producing wells. The discovery well was completed pumping 236 barrels of 35° API gravity oil per day, and a southwest offset well was completed pumping 351 barrels of 35° API gravity oil per day. The nearest Minnelusa production is three miles east at Worth Field.

R. Yates Petroleum completed a Minnelusa wildcat in section 9, T.49N., R.72W., pumping 190 barrels of 27° API gravity oil and four barrels of water per day. The well is nearly a mile northeast of the Minnelusa Einer Field discovery.

S. Maxim Drilling and Exploration completed a Minnelusa discovery, pumping 205 barrels of oil daily. The well is in section 30, T.48N., R.70W. and is over a mile northeast of Minnelusa production at Rocky Butte Field.

Reference cited

Petroleum Information, 1988, Rocky Mountain Region report: June 22, p. 9.

COAL UPDATE

by Richard W. Jones, Coal Division Head, Geological Survey of Wyoming

Wyoming coal production for 1988 could be headed for another all-time record, based on early coal delivery and production reports. Coal deliveries from Wyoming coal mines in the first quarter of 1988 were about 2.4 million short tons more than deliveries made during the same period in 1987 (see table on page 13 and figure on page 14), and weekly coal production reports compiled by the Energy Information Administration also show the State's 1988 production through May ahead of production for the same period in 1987. With drought conditions in much of the United States reducing the amount of electricity that can be generated by hydroelectric plants and with the prospects for hot temperatures to continue through the summer (creating more demand for electricity to power air conditioning units), Wyoming coal will be in high demand this year. This high demand, coupled with low coal prices, could result in Wyoming's 1988 coal production substantially exceeding that of last year.

Recently available data on the distribution and utilization of coal in 1987 (Energy Information Administration, 1988) indicates that Wyoming coal was used in 25 states (see figure on page 15). As in years past, Texas was the largest consumer of Wyoming coal in 1987, followed by Wyoming and Kansas. Compared with coal distribution in 1986, significant decreases in the consumption of Wyoming coal were recorded in five states: Illinois (1.7 million tons less), Arkansas (1.4 million tons less), Indiana (0.8 million tons less), Oklahoma (0.4 million tons less), and Colorado (0.4 million tons less). Significant increases in Wyoming coal usage were recorded by Minnesota (3.2 million tons more in 1987), Texas (2.6 million tons more), Iowa (2.2 million tons more), and Louisiana (1.7 million tons more). Six states each consumed over ten million tons of coal. Four states consumed nearly 50 percent of Wyoming's coal, and nine states consumed about 80 percent of Wyoming's coal.

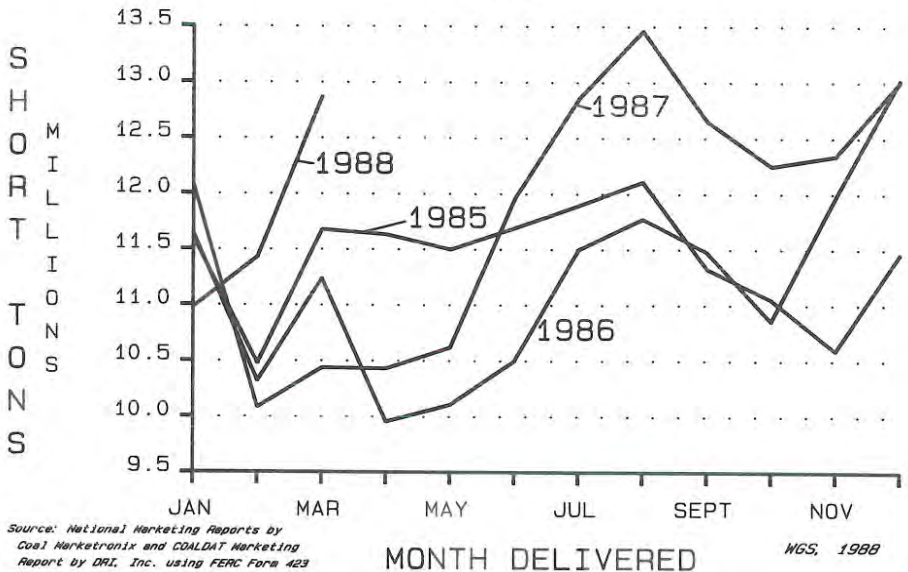
Electric utility companies located in 20 different states used nearly 98 percent of Wyoming's total coal production in 1987 to fuel steam-electric generating plants (see figure on page 18). Seventeen different states used Wyoming coal to fuel industrial boilers and to

COAL DELIVERIES BY MONTH FROM WYOMING MINES

	1984		1985		1986		1987		1988	
	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE
JANUARY	9,540,200	9,540,200	11,601,200	11,601,200	11,646,300	11,646,300	12,085,570	12,085,570	10,976,860	10,976,860
FEBRUARY	9,654,600	19,194,800	10,473,900	22,075,100	10,317,700	21,964,000	10,315,680	22,401,250	11,431,380	22,408,240
MARCH	10,875,000	30,069,800	11,674,900	33,750,000	11,401,720	33,365,720	10,436,610	32,837,860	12,871,090	35,279,330
APRIL	8,721,400	38,791,200	11,632,800	45,382,800	9,954,170	43,319,890	10,429,180	43,267,040		
MAY	9,481,500	48,272,700	11,497,900	56,880,700	10,105,320	53,425,210	10,619,470	53,886,510		
JUNE	9,464,500	57,737,200	11,692,200	68,572,900	10,499,280	63,924,490	11,953,650	65,840,160		
JULY	11,019,600	68,756,800	11,893,500	80,466,400	11,497,190	75,421,680	12,850,240	78,690,400		
AUGUST	11,433,000	80,189,800	12,107,100	92,573,500	11,773,510	87,195,190	13,460,470	92,150,870		
SEPTEMBER	10,440,000	90,629,800	11,325,000	103,898,500	11,474,820	98,670,010	12,651,550	104,802,420		
OCTOBER	10,492,500	101,122,300	11,048,500	114,947,000	10,854,670	109,524,680	12,248,080	117,050,500		
NOVEMBER	11,814,200	112,936,500	10,589,700	125,536,700	11,971,990	121,496,670	12,340,720	129,391,220		
DECEMBER	11,486,800	124,423,300	11,459,300	136,996,000	13,025,490	134,522,160	13,008,300	142,399,520		
TOTAL TONNAGE REPORTED	124,423,300		136,996,000		134,522,160		142,399,520			
TOTAL TONNAGE NOT REPORTED	6,322,479		3,784,154		1,782,896		4,089,128			
TOTAL TONNAGE PRODUCED	130,745,779		140,780,154		136,305,056		146,488,648			

Source: National Marketing Reports by Coal Marketronix, compiled from FERC Form 423 filed monthly by electric utilities. Annual Reports of Wyoming State Mine Inspector and Ad Valorem Tax Division.

REPORTED DELIVERIES FROM WYOMING COAL MINES

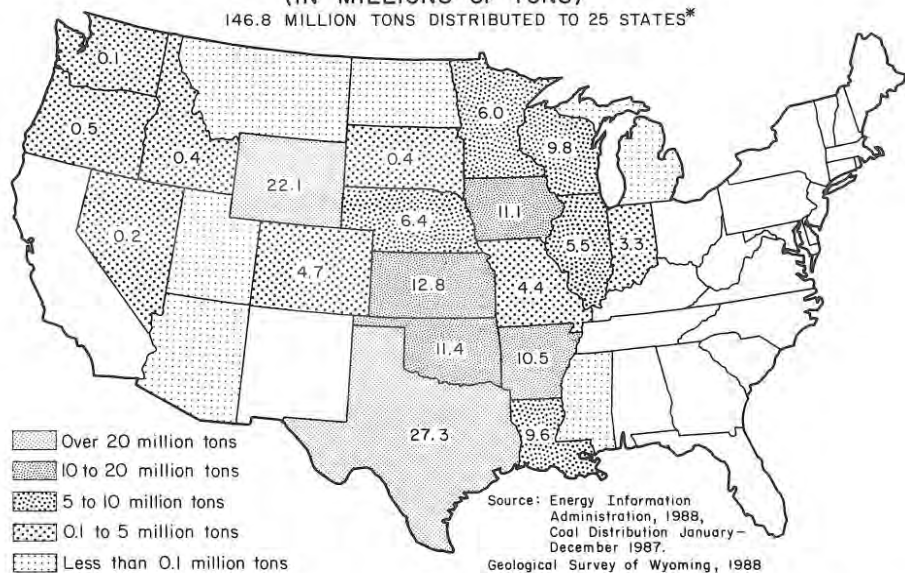


provide residential/commercial heating. About 1.9 million tons of the 3.5 million tons in the "other industrial" and "residential/commercial" categories went to Wyoming users. Most of this coal was used by other mineral-related industries in the State, including the trona and bentonite industries. Additional coal was used at FMC Corporation's formcoke plant in Lincoln County (noncoking subbituminous coal is converted to formcoke through the company's patented process) and by a sugar beet processing plant. Although 85 percent of Wyoming's coal was shipped to out-of-state consumers, a small amount of coal (18,500 tons) was imported into the State from Colorado, Utah, and Pennsylvania.

Transportation of Wyoming coal in 1987 (see figure on page 18) was primarily by rail (92 percent); coal transported by river refers to coal that reached its final destination by river barge after originating on a railroad. Burlington Northern Railroad (BN) accounted for 68 percent of all Wyoming's coal that was shipped by rail in 1987. Western Railroad Properties, Incorporated, (WRPI), which reports tonnages carried by the Chicago and North Western (C&NW)/Union Pacific (UP) joint-venture railroad, accounted for 25 percent of the coal carried by rail. WRPI carried 9.6 million tons more coal in 1987 than it carried in 1986. The Union Pacific Railroad Company, serving mines in southern and western Wyoming, recorded a slight decrease in rail tonnage. Coal accounted for 92 percent of the total tonnage of railroad freight that originated in Wyoming in 1987.

DISTRIBUTION OF WYOMING COAL, 1987
(IN MILLIONS OF TONS)

146.8 MILLION TONS DISTRIBUTED TO 25 STATES*



Source: Energy Information Administration, 1988, Coal Distribution January-December 1987. Geological Survey of Wyoming, 1988

**The Energy Information Administration's 1988 coal production for Wyoming is about 0.3 million tons more than the production reported by the Wyoming State Inspector of Mines. The difference is most likely a result of independent rounding of production figures. The difference is not significant.*

In coal transportation news, KN Energy, Inc. and South Dakota are the latest entities to receive damage payments from several railroads. In early 1988, KN Energy, Inc., a partner in the Energy Transportation Systems, Inc. (ETSI) coal-slurry pipeline project, received \$8.2 million in an out-of-court settlement with the UP and C&NW railroads. In a separate action, the State of South Dakota was awarded \$200 million in damages in a lawsuit filed against Kansas City Southern Railway Company (KCS). A Federal court jury ruled that KCS conspired with other railroads to stop the ETSI project, and caused restraint of trade in the coal transportation market, hurt interstate commerce, and damaged the State of South Dakota. The damages awarded to South Dakota were for profits the state could have made by selling Missouri River water to the pipeline project. The award could be tripled under the antitrust laws. An appeal was filed by KCS following the court's decision.

MINERAL RESOURCE AND RESERVE BASE ESTIMATES FOR WYOMING

PETROLEUM

Remaining Resources (January 1, 1987)	
Discovered (Includes 10 billion barrels recoverable by enhanced recovery techniques)	13.3 billion barrels ¹
Undiscovered	7.6 billion barrels ¹
Total	20.9 billion barrels
Remaining Reserve Base (January 1, 1987)	
Measured reserves (Proved reserves)	0.83 billion barrels ²
Indicated and inferred reserves	2.8 billion barrels ³
Total	3.63 billion barrels

NATURAL GAS

Remaining Resources (January 1, 1987)	
Discovered	18.6 trillion cubic feet ¹
Undiscovered (there is at least another 115 trillion cubic feet of noncombustible CO ₂ gas) ⁹	58.0 trillion cubic feet ¹
Total	76.6 trillion cubic feet ¹
Remaining Reserve Base (January 1, 1987)	
Measured reserves (Proved reserves)	10.64 trillion cubic feet ²

COAL

Remaining Resources (January 1, 1988)	
Identified (Discovered)	135.8 billion tons ⁴
Undiscovered	800.0 billion tons ⁵
Total	935.8 billion tons
Remaining Reserve Base (January 1, 1988)	
Demonstrated strippable (Measured and indicated reserve base)	26.9 billion tons ⁴
Demonstrated underground-minable (Measured and indicated reserve base)	38.4 billion tons ⁴
Total	65.3 billion tons

TRONA

Original Resources (1983 estimate)
Trona.....81.7 billion tons⁶
Mixed trona and halite..... 52.7 billion tons⁶
Total.....134.4 billion tons

URANIUM

Remaining Resource (December 31, 1985)..... 1.99 billion pounds U₃O₈
Remaining Reserve Base (December 31, 1985)..... U₃O₈
Uranium oxide recoverable at \$30.00 per pound 83 million pounds

OIL SHALE

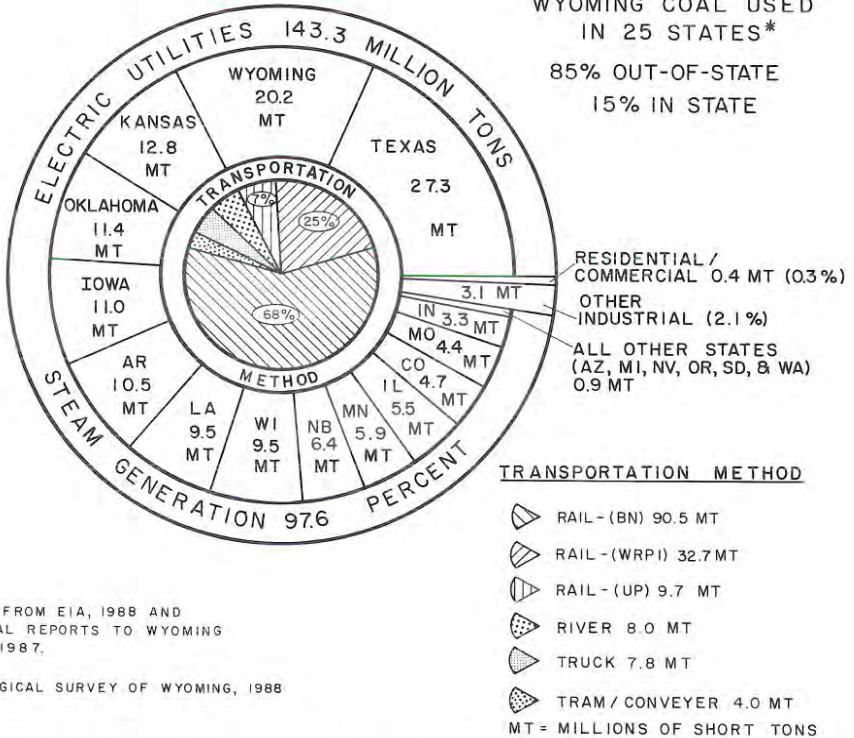
Original Resources (January 1, 1983)
Identified (Discovered).....320 billion barrels of shale oil⁸

- 1 Modified from Barlow, J.A., Jr. and Doelger, M.J., 1983, *Wyoming mineral resources: Barlow and Haun, Inc., Casper*, 14 p.
- 2 Energy Information Administration, 1987, *U.S. crude oil, natural gas, and natural gas liquids reserves: 1986 Annual Report*, October. (1986 production has been subtracted).
- 3 Modified from Barlow and Doelger (1983), footnote 1.
- 4 Geological Survey of Wyoming, June, 1988. (Modified from Berryhill, H.L., Jr. and others, 1950, *Coal resources of Wyoming: U.S. Geological Survey Circular 81*, 78 p.
- 5 Averitt, Paul, 1975, *Coal resources of the United States: U.S. Geological Survey Bulletin 1412*, p. 15.
- 6 Culbertson, W.C., 1983, *Genesis and distribution of trona deposits in Wyoming (abstract) in Genesis and exploration of metallic and nonmetallic mineral and ore deposits of Wyoming and adjacent areas: Geological Survey of Wyoming Public Information Circular 19*, p. 34.
- 7 Energy Information Administration, 1985, *Uranium industry annual: U.S. Department of Energy Report DOE/EIA-0478(85)*, 142 p.
- 8 Knutson, C.F., and Dana, G.F., 1982, *Developments in oil shale in 1981: American Association of Petroleum Geologists Bulletin*, Volume 66, no. 11, p. 2513.
- 9 Derived from Exxon information.

UTILIZATION AND TRANSPORTATION OF WYOMING COAL, 1987

146.8 MT OF WYOMING COAL USED IN 25 STATES*

85% OUT-OF-STATE
15% IN STATE



DATA FROM EIA, 1988 AND ANNUAL REPORTS TO WYOMING PSC, 1987.

GEOLOGICAL SURVEY OF WYOMING, 1988

*The Energy Information Administration's 1988 coal production for Wyoming is about 0.3 million tons more than the production reported by the Wyoming State Inspector of Mines. The difference is most likely a result of independent rounding of production figures. The difference is not significant.

The proposed merger of PacifiCorp, the parent company of Pacific Power and Light Company (PP&L), and Utah Power and Light Company (see *Wyoming Geo-notes No. 17*, January, 1988, p. 16) was set back in June when an administrative law judge for the Federal Energy Regulatory Commission (FERC) recommended that the merger be disallowed. The judge's opinion concluded that the merger would be anti-competitive and against the public interest, primarily because the merged corporation would eliminate competition in western power markets and would make it impossible for FERC and the seven state utility commissions to regulate the new corporation. The argument against the merger on the grounds that it would eliminate competition for electric utility fuel from Utah coal mines was rejected in the judge's opinion -- he found western coal markets to be competitive.

In another legal issue involving Wyoming coal, in April the State of Wyoming filed a lawsuit in the U.S. Supreme Court to overturn an Oklahoma law that requires coal-fired power plants in that state to buy at least ten percent of their coal from Oklahoma producers. The State of Wyoming contends that the Oklahoma law is an unconstitutional burden on interstate commerce in that it restricts interstate sale of products. It is estimated that Wyoming is losing nearly a million dollars a year in severance taxes from decreased sales to Oklahoma utility companies. In 1985, Oklahoma used 12.9 million tons of Wyoming coal; in 1986, Oklahoma used 11.8 million tons; and in 1987, Oklahoma used 11.4 million tons of Wyoming coal.

Several other states that burn large amounts of Wyoming coal are considering legislation (or have already passed legislation) similar to the Oklahoma law. Arkansas passed legislation in 1987 that will require coal-fired utility plants to use ten percent Arkansas coal by 1990; Kansas and Missouri are reportedly close to enacting similar laws. The Wyoming vs. Oklahoma lawsuit will have an important impact on present contracts and future coal sales to many states. It may also impact other State legislation aimed at limiting sulfur dioxide emissions at power plants.

Carbon County/Hanna Basin developments

Several positive developments occurred in this area in the second quarter of 1988. First, Cyprus Shoshone Coal Company reached an agreement with Northern Indiana Public Service Company (NIPSCO) on a 14-year, 1.3 million tons per year coal supply contract. The coal will be used at NIPSCO's power plants in Indiana and will be transported by Union Pacific Railroad. As a result of this new contract, Cyprus Shoshone announced that an additional 70 underground coal miners would be hired by June; by that time the company expects to have a total of 150 miners working.

In the second development, Arch of Wyoming (formerly Arch Mineral Corporation) announced that their Medicine Bow mine would reopen and that eight employees would be called back to work. If additional sales are obtained, four to seven additional employees will be needed. The mine secured several spot sales to Kansas Power and Light earlier this year and in April, Medicine Bow secured another contract for 75,000 to 125,000 tons of coal with Colorado Springs' Department of Utilities.

Development of underground coal gasification projects in both the Hanna and Rawlins areas (see *Wyoming Geo-notes No. 12*; October, 1986, p. 28-29) continued in the second quarter of 1988. The Energy International (EI) project at North Knobs won a siting permit from the Wyoming Industrial Siting Council in June after a "fast-track" permit review. The project will burn steeply-dipping coal seams underground, recover the gas emitted, and use the gas to produce ammonia. Construction of the project, which was to begin this June, was postponed while EI tried to obtain necessary outside financing. Construction on the project, which will require up to 710 workers, is expected to contribute much to the economy of Rawlins, six miles east of the project site.

At the underground gasification site near Hanna, the first two phases of a seven-year project were recently completed. The Gas Research Institute and the U.S. Department of Energy are sponsoring the project, which has been named Rocky Mountain I. The project consists of examining both a modified "linked-vertical-well" concept, which has been used in many underground gasification projects, as well as a "controlled-reacting-injection point" (CRIP) process. Recently completed phases of the project have gasified more than 14,000 tons of coal over a span of 102 days to produce 700 million cubic feet of gas. The recovered gas had a heating value of 250-320 Btu and a methane content of 7 to 11 percent.

Western and southwestern Wyoming developments

In a move to make their operations more efficient, two coal mines east of Rock Springs announced in late May that they would merge operations. Prospect Point Coal Company, a wholly-owned subsidiary of Union Pacific Resources and operator of the Leucite Hills mine (west of the Jim Bridger mine), and Black Butte Coal Company, a joint venture of Union Pacific Resources and Peter Kiewit Sons, Inc., became an integrated operation known as Black Butte Coal Company on June 1. The consolidation of operations occurred when Union Pacific Resources sold 50 percent of their interest in Prospect Point Coal Company to Peter Kiewit Sons, Inc. As a result of this merger, the Leucite Hills mine will now be known as Black Butte's "Pit 22". In early July, Black Butte announced that 20 workers at the combined operation would be laid off, bringing the total combined workforce down to 365. At the end of 1986, the employment at both mines totaled 544; at the end of 1987, the two mines employed 399. Contracts currently held by both companies for each mine will remain in force.

Black Butte Coal Company also acquired a new spot coal sale during the second quarter. Pacific Power and Light Company (PP&L) will purchase a minimum of 500,000 tons of Black Butte coal for the Jim Bridger power plant about 15 miles north of Black Butte. The contract is for one year and contains escalation options for delivery of even more coal if needed. The coal will be delivered by truck through a contract with Savage Trucking Company. No price data for the coal was announced. Earlier this year, PP&L renegotiated their contract with NERCO's Jim Bridger mine and announced their intention to purchase additional coal from other mines for the Bridger generating plant.

In other developments, Bitter Creek Resources, the owner of the Stansbury underground mine at Rock Springs, recently received a \$950,000 loan guarantee from the Wyoming Investment Fund Committee to help reopen the mine, which has been closed since 1981. If a customer (or customers) for the high-Btu coal can be obtained, the mine will produce 450,000 tons a year and employ 24 miners.

In northern Lincoln County (Hams Fork Coal Region), the U.S. Office of Surface Mining, Reclamation, and Enforcement and the U.S. Forest Service recently completed an environmental assessment on an underground coal mine proposed by Wy-Ida Coal Company of Idaho Falls, Idaho. The company wants to reopen the Deadman mine, which was last active in 1962, and market the relatively high quality coal in the Afton/Star Valley area as well as in the Idaho Falls-Pocatello area. Wy-Ida had applied for a \$250,000 community development block grant loan with the Wyoming Economic Development and Stabilization Board (EDS Board) for road improvements into the mine site and for working capital, but in late June, the company's application was rejected by the EDS Board.

Powder River Basin developments

Employment at Powder River Basin coal mines continued downward in the second quarter of 1988 as Amax Coal Company announced in April that 90 hourly and 20 salaried employees would be laid off permanently at the company's Eagle Butte and Belle Ayr coal mines. By asking for voluntary layoffs, the company accepted a total of 128 layoffs (108 hourly and 20 salaried). Amax attributed the layoffs to poor market conditions (low prices), excess production capacity in the Powder River Basin, and a reduction in their coal deliveries to existing customers.

Carbon Fuels Corporation, the owner of subsidiary Char-Fuels Development Ltd. received another \$8.5 million loan from Wyoming's clean coal technology program in May, which brings the State's total investment in the Char-Fuels project to \$16.5 million. The company hopes to build a demonstration plant for char-fuels, a coal-oil-carbon particle slurry, designed for burning in a power plant. Glenrock will apparently be the location of the demonstration plant. PP&L has agreed to support the project by providing the coal and a plant site near the Dave Johnston power plant. The final location for the first full-scale plant has yet to be decided. To qualify for the State loan, Char-Fuels must secure additional private financing of \$25 million. The company is also seeking \$50 million from the U.S. Department of Energy.

In a related development, K-Fuels, another recipient of State of Wyoming loan money for clean coal technology (\$11.7 million), recently announced that their test plant located at the Fort Union coal mine north of Gillette was ready for production of K-Fuel, a low moisture, high-Btu fuel pellet. K-Fuels has a contract with Wisconsin Power and Light for test-burning the pellets.

Several new coal supply contracts involving Powder River Basin mines were signed in the second quarter:

1) South Dakota Cement Company extended their coal supply contract with Wyodak Resources Development Corporation for an additional five years with a slight reduction in price. About 170,000 tons of coal per year are shipped to South Dakota under this contract. The contract will now expire in 1994 instead of 1989.

2) Amax Coal Company's Belle Ayr mine supplied NIPSCO's Dean Mitchell plant with 60,000 tons of spot coal during May and 40,000 tons of spot coal in April. NIPSCO will probably purchase more spot coal on an as-needed basis during the second half of 1988.

3) Two new fluidized-bed combustion units, one at Lincoln, Nebraska, and one at Mankato, Minnesota, are purchasing coal from the Black Thunder and Rochelle coal mines, respectively. Archer-Daniels-Midland is operating these new units and are evidently experimenting with a variety of coals in test burns. The Mankato unit will consume about 80,000 tons of coal per year.

4) Thunder Basin Coal Company's six-month contract with Southwestern Public Service Company to supply coal to the Roy Tolk generating plant (see *Wyoming Geo-notes No. 18*, April, 1988, p. 19) has been extended to the end of 1988 and will allow the utility to purchase an additional 300,000 to 500,000 tons of coal from either Coal Creek or Black Thunder mines during the second half of 1988.

5) Rochelle Coal Company will supply Southwestern Public Service Company's Harrington generating plant at Amarillo, Texas, with 150,000 to 300,000 tons of spot coal from March to December, 1988. The actual tonnage is subject to Southwestern's power sales to other utilities. Thunder Basin Coal Company's Black Thunder mine supplies about three million tons of coal per year to the three Harrington generating units under a long-term contract.

6) Rochelle Coal Company (a division of Powder River Coal Company, a wholly-owned subsidiary of Peabody Holding Company, Inc.) also won a six-month contract to supply coal to Fremont, Nebraska's Department of Utilities. The Rochelle mine will supply 25,000 to 40,000 tons of coal for \$15.60 per ton delivered. The coal will be delivered (starting in June) by Burlington Northern and Chicago and North Western railroads for \$11.00 per ton. The resultant F.O.B. mine price of the coal is \$4.60 per ton. Published mine prices for this coal supply solicitation were as low as \$3.75 per ton (Carter's Rawhide mine), \$4.00 per ton (Carter's Caballo mine, estimated), \$4.25 per ton (Amax Coal Company, estimated), and \$4.50 per ton (Jacobs Ranch, estimated), but because Rochelle's coal averages about 8,800 Btu per pound, their delivered price per million Btu was lowest (at 88.6¢).

Reference cited

Energy Information Administration, 1988, Coal distribution, January-December, 1987: U.S. Department of Energy Report DOE/EIA-0125 (87/4Q), 181 p.

INDUSTRIAL MINERALS AND URANIUM UPDATE

by Ray E. Harris, Industrial Minerals and Uranium Division Head,
Geological Survey of Wyoming

Industrial Minerals

All of Wyoming's current nonfuel mineral production is classified under the term "industrial minerals". According to the *Glossary of geology* (Bates and Jackson, 1980), industrial minerals are any rocks, minerals, or other naturally occurring substances of economic value, exclusive of metallic ores, mineral fuels, and gemstones. Industrial minerals include trona, gypsum, bentonite, sand and gravel, and others. The following is an update on industrial mineral developments in the second quarter of 1988. For general information on all of Wyoming's industrial minerals, see *Wyoming Geo-notes No. 18*, p. 19-26.

Aggregate

Denver, Colorado, is proceeding with new airport development and a large quantity of decorative and construction aggregate will be required. Because aggregate sources near the airport may not be suitable for quarrying due to their proximity to residential areas, demand for Wyoming aggregate for the Denver area could increase while the airport is under construction.

Ballast

Meridian Minerals, a subsidiary of Burlington Northern, Inc., purchased the ballast quarry at Granite, Wyoming, (southern Laramie Mountains) from Morrison-Knudsen. This quarry is still supplying ballast for the Union Pacific Railroad, as well as for the new owners, Burlington Northern. Total production of ballast from this quarry should increase.

Bentonite

The American Bentonite Corporation is progressing with its plans to develop a pit west of Casper (on the Casper Arch) near the Poison Spider School. Currently, a permit to mine this area is pending before the Wyoming Environmental Quality Council. Meanwhile, Kaycee Bentonite Corporation of Casper recently applied for a permit to mine bentonite in the same area. That permit is under review by the Land Quality Division of the Department of Environmental Quality.

The American Colloid Company purchased some bentonite properties and processing facilities in the Black Hills area from Federal Ore and Chemical Company. American Colloid also purchased a taconite processing facility in Minnesota. Among other uses, bentonite is used as a binder to mold raw taconite into pellets suitable for smelting into iron.

Decorative stone

A Colorado distributor of decorative aggregate and stone inspected several types of stone in eastern Wyoming, with the assistance of the Geological Survey of Wyoming. Small scale quarrying may begin soon in these areas to test the Wyoming stones. Following this testing, larger production could develop if the rocks are marketable.

In addition to the Colorado company, a midwestern manufacturer of precast concrete has examined several rock deposits in Wyoming. Should these be suitable for decorative aggregate used in precast concrete, additional development could take place.

Demand for dimension stone for large building construction is increasing according to an article in *Compressed Air* (May, 1988). Currently, large quantities of exterior and interior facing stone are being imported. This growing use of stone may present an opportunity for development of dimension stone quarries in Wyoming. Granite, travertine, marble, limestone, sandstone, onyx, and other dimension stone are found in suitable quantities in Wyoming. For more information about the locations of these stone deposits, see Geological Survey of Wyoming Map Series 21, *Construction materials map of Wyoming*.

Phosphate

FMC announced a 50 percent expansion in production of sodium tripolyphosphate from its plant adjacent to its trona mine and soda ash refinery in Sweetwater County. FMC mines phosphate in Idaho and combines the phosphate with sodium from soda ash at its plant near Green River. This increase in production expands FMC's output of tripolyphosphate, which is used in fertilizer, to 450 million pounds per year.

Silica sand and silica rock

Silica sand and silica rock deposits in Wyoming continue to attract attention. In addition to two companies' interests in the Plumbago Creek deposit (*Wyoming Geo-notes No. 18*, p. 24), two companies have expressed interest in a deposit near Cassa (Platte County), and one has visited the site. Report of Investigations 42, which describes the Cassa deposit, is now available from the Geological Survey of Wyoming (see page 34).

Sulfur

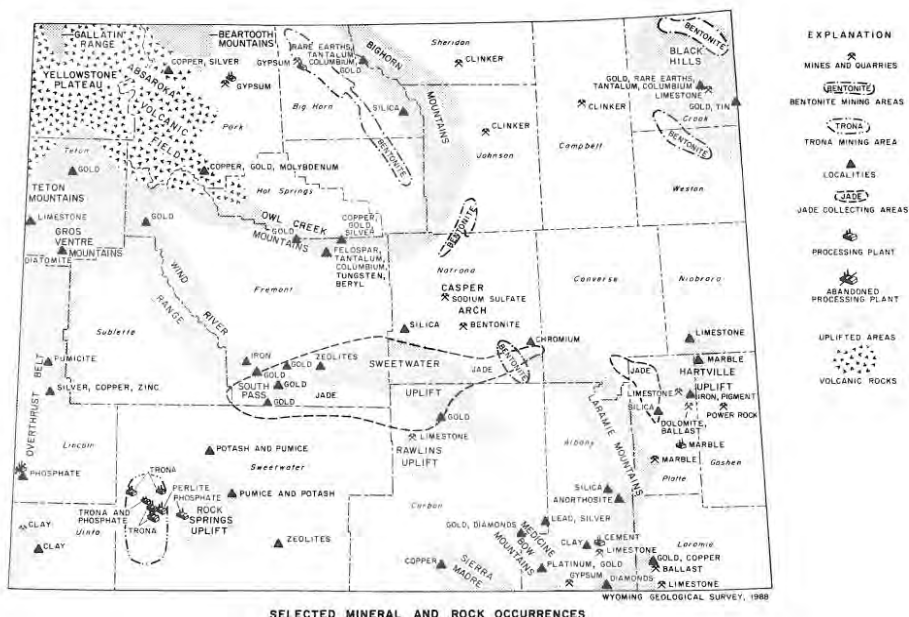
Sulfur production and consumption has begun to increase in the United States according to figures released by the U.S. Bureau of Mines. This reverses a four-year trend. Interest in Wyoming sulfur deposits continues, and one company, Wyoming Sulfur, has applied to the city of Thermopolis for funds from the Wyoming Economic Develop-

ment and Stabilization Board (EDS Board) to conduct an exploratory drilling program. However, there is currently a moratorium on EDS Board grant money for these kinds of projects.

Trona

Trona mining and soda ash (refined trona) production continues to set records in Wyoming. Production during the first quarter of 1988 was 20 percent more than the record levels set during the first quarter of 1987 according to the U.S. Bureau of Mines. This growth is due to increased domestic demand for soda ash, used primarily in the manufacture of glass. At the same time, trona exports, considered to be the best hope for significant growth in the industry, declined by seven percent over those of the corresponding period last year.

Increases in trona production have not helped all soda ash producers. Tg Soda Ash cut production in April and laid off nine workers. In related news, Stauffer Chemical's soda ash plant has been purchased by a French National company.

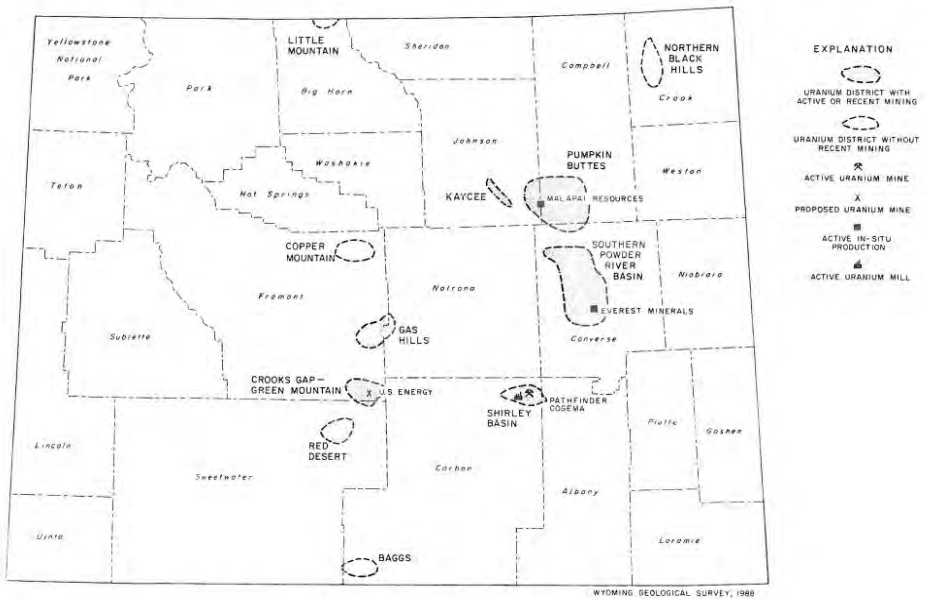


Uranium

Uranium issues were in the news during the second quarter of 1988. Federal legislation related to the domestic uranium industry was introduced in Congress, but defeated. And a decision which banned the U.S. Department of Energy from enriching foreign uranium for use in domestic nuclear power plants was unanimously rejected by the U.S. Supreme Court. There was a uranium seminar in Riverton on April 5th, and two Wyoming *in situ* uranium producers announced expansion plans while the Lucky Mc mill in the Gas Hills closed (see map this page). Contractors began moving old uranium mill tailings from the former Susquehanna-Western mill at Riverton to a mine disposal site in the Gas Hills district.

Federal revitalization issues

Federal revitalization plans for the uranium industry were considered and turned down by Congress during the second quarter of 1988. Legislation that would have required the U.S. Government to purchase domestic uranium for government-owned enrichment plants and which would have required U.S. utilities to purchase at least 50 percent of their uranium from domestic producers was passed by the U.S. Senate, but was defeated by the U.S. House of Representatives. This bill would have provided a market for domestic uranium. Opponents said it would be detrimental to the U.S./Canada Free Trade Agreement. Most foreign uranium imported into the U.S. comes from high-grade, low-cost Canadian deposits.



The U.S. Supreme Court unanimously rejected an earlier ruling by a U.S. District Court. This earlier ruling stated that if the United States' uranium industry was deemed nonviable by the U.S. Department of Energy (DOE), the DOE must stop enriching foreign uranium for use in U.S. nuclear power plants. The U.S. uranium industry has been deemed nonviable for the past two years. The Supreme Court's ruling; however, set limits on DOE's power to restrict foreign imports of uranium. In its decision, the high court ruled that the DOE's actions related to uranium viability were limited to actions that help "assure" a viable industry. As a result of the Supreme Court's ruling, the uranium industry has set out to convince the Colorado District Court that restrictions on the enrichment of foreign uranium will help assure a viable domestic industry. The U.S. Government operates all domestic enrichment plants. If these plants do not enrich foreign uranium, they will, in effect, ban imports of uranium oxide (yellowcake).

Uranium Industry seminar

On April 5th, a seminar "Uranium Roundtable '88" was held in Riverton, with a dinner and welcoming speech by Governor Mike Sullivan on April 4th. This conference was sponsored by several Riverton area governmental agencies and private industry and by several mining organizations and associations. The current state of the industry in Wyoming was presented by a uranium producing company, a company developing a uranium deposit in Wyoming, and the Geological Survey of Wyoming. Other topics presented at the seminar included the status of *in situ* mining, the mine permitting process, uranium taxation, the U.S./Canada Free Trade Agreement and its effects on Wyoming uranium, bonding practices, reclamation, and uranium viability. Since the Federal issues discussed above had not been resolved at the time of the seminar, the industry was cautiously optimistic about expansion in Wyoming. It was stated that bonding and permitting processes had been streamlined and that reclamation and taxation issues could be faced. However, the general feeling at the roundtable was that if the pending Federal actions were unfavorable (which it turned out they were), there was little hope of much growth in the uranium industry in Wyoming at least in the short term.

Wyoming uranium today

Uranium is currently mined in Wyoming at three sites (see map on page 26): at the Pathfinder-COGEMA mine in the Shirley Basin, at Everest Minerals' *in situ* mine northwest of Douglas, and at Malapa Resources' *in situ* mine west of the Pumpkin Buttes. The Lucky Mc mill, which had recently been modernized, closed down permanently after processing some stockpiled ore in 1987 and early 1988. U.S. Energy is proceeding with development of a proposed underground mine on Green Mountain south of Jeffrey City and is evaluating some other properties in the Crooks Gap district.

The two *in situ* producers are expanding production. Everest Minerals has a capacity of 2 million pounds of yellowcake (uranium

oxide) per year. Malapai Resources has announced plans to increase its production threefold, to one million pounds/year.

It is likely that production from conventional uranium mines in Wyoming will remain at about 30,000 tons of ore/year and that *in situ* production will increase slowly at first and then go to about 3 million pounds of yellowcake by 1990 (see table on page 2). The future of the mine at Shirley Basin is dependent on foreign markets. The production from this mine is processed in France to fuel nuclear power plants in Japan.

The much-discussed move of uranium tailings from the abandoned Susquehanna-Western uranium mill south of Riverton to an abandoned uranium open pit mine in the Gas Hills is underway. About 50 large trucks are hauling the tailings, each making several round trips from the mill to the mine during an 18-hour work day. Operations are proceeding smoothly although because the water content of the old tailings is higher than predicted, it is causing some compaction problems at the disposal site. The move should be completed by early fall.

Reference cited

Bates, R.L. and Jackson, J.A., editors, 1980, Glossary of geology: American Geological Institute, second edition, p. 316.

METALS AND PRECIOUS STONES UPDATE

by W. Dan Hausel, Deputy Director, Geological Survey of Wyoming.

In the second quarter, exploration activity for metals in Wyoming increased as snow melted from the high mountainous regions. Unfortunately, competition between companies for choice targets resulted in so much secrecy that discussions of some projects and activities are not possible.

In the Black Hills of northeastern Wyoming, gold exploration was continuing in the Bear Lodge and Mineral Hill districts. Both districts are situated in Tertiary alkalic igneous complexes with the major emphasis on low-grade gold in fentes and jasperoids.

In the Bear Lodge district, at least two major U.S. companies continued outlining gold mineralization by geochemical and drilling exploration programs. The gold occurs in 38- to 50-million-year-old potassium fentitized alkalic igneous rocks that also show enrichments in rare-earth elements, thorium, copper, lead, and zinc. Gold in this district is reported in feldspathic breccia, manganiferous trachyte, fissure veins, fluorite-pyrite veins, and along unconformities between trachyte and the Cambrian Deadwood Formation.

In the nearby Mineral Hill district located 15 miles to the southeast, gold and tin have sporadically been mined during the past 100 years from placers draining the Tertiary igneous complex. Present exploration in the district, however, is principally for low-grade gold mineralization in feldspathic breccias and jasperoid.

Mining companies are again planning for exploration in the Medicine Bow Mountains in Albany and Carbon Counties in southeastern Wyoming. This exploration is primarily for platinum and palladium mineralization in the large, Proterozoic (about 1.8-billion years old), layered Lake Owens and Mullen Creek mafic complexes. One Canadian company, and at least three major U.S. mining firms have holdings in the region. There is again some interest in the potential for gold-bearing quartz pebble conglomerates (2 to 2.5-billion years old) in the Medicine Bow Mountains and Sierra Madre.

Prospectors are also working along Douglas Creek and its tributaries with small recreational dredges. One group reported recovering a 2.5 ounce nugget from a placer in the eastern portion of the district.

The *Casper Star-Tribune*, May 27, 1988, reported that Calclitron Metals Incorporated of Salt Lake City, Utah, planned to build a mill in Sweetwater County to process gold ore from a proposed mine in Draggett County, Utah. No other information is available.

In the South Pass greenstone belt in Fremont County in west-central Wyoming, exploration and prospecting activities are expected to increase as summer progresses. This summer, a minimum of one Canadian, two Australian, eight U.S. companies, and dozens of prospectors are expected to search the Archean greenstone belt and nearby Tertiary paleoplacers for gold. At least four drilling projects are planned.

The Geological Survey of Wyoming continued to study the greenstone belt and collected another interesting suite of samples along the northern edge of the belt. Twelve samples collected from a mine developed on a carbonated milky quartz vein and shear in greenstones and metabasalt of tholeiitic affinity, yielded 0 to 37 ppm (1.08 oz/ton) gold, 0 to 19 ppm (0.55 oz/ton) silver, and 0.01 to 3.5 percent copper.

Some diamond exploration is expected this summer in Wyoming. The Geological Survey of Wyoming continued to outline a large area in the central Laramie Mountains of Albany County that may have potential for diamond deposits. More than two dozen samples collected by the State Geological Survey in this region have yielded minerals that are characteristic of kimberlite or some other related rock. Although only a small percentage of kimberlite intrusives contain diamonds, kimberlite is one of only two known rock types that have been mined for diamonds.

Carr Boyd, an Australian gold and diamond exploration company, reported that it intends to explore the Colorado-Wyoming kimberlite district and portions of the Wyoming Province for diamonds during the next few years.

STRATIGRAPHY UPDATE

by Alan J. Ver Ploeg, Stratigraphy Division Head, Geological Survey of Wyoming

The Geological Survey of Wyoming recently released an update of *Ongoing studies on the geology of Wyoming*. This report, designated Open File Report 88-9, provides titles and brief descriptions of studies on Wyoming geology that are currently underway. Recently published articles are listed where they are related to ongoing studies. Entries are arranged by State and by institutions within each State. The report also includes a subject index. The information used to compile the listing was obtained by mailing questionnaires to various universities and government agencies. A total of 141 entries are included in this updated report. See page 34 for price and ordering instructions.

On a related note, the Stratigraphy Division is currently updating Public Information Circular 24, *Bibliography of graduate theses and dissertations on the geology of Wyoming 1899 through early 1984 - exclusive of the University of Wyoming*. Letters were sent to various universities around the country requesting thesis and dissertation lists which are being searched for Wyoming-related projects. Numerous responses have already been received and several corrections and many additions to the previous listing have already been made. This update should be completed before the end of the year.

A Division employee, Phil Greer, recently participated in the University of Wyoming College of Agriculture's 4-H summer camp at the Fremont Camp southwest of Lander. He presented two-hour, hands-on workshops to four groups of young people on June 21st. The workshop introduced the teenage groups to rocks and minerals and their identification, stressing the types of rocks and minerals present in the camp area. This is the third time the State Geological Survey has assisted with this summer field camp.

In regard to the Division's cooperative mapping project with the U.S. Geological Survey (COGEO MAP), Division personnel have mapped a total of five quadrangles since the inception of the project in 1985. These five quadrangles, which are on the east flank of the southern Bighorn Mountains, are shown on the Index map on page 33. This summer the Tallon Spring and Turk Springs Quadrangles are being mapped. These quadrangles are shown on the Index map (page 33) with dashed lines. Contrary to *Wyoming Geo-notes* No. 18, the Tallon Spring Quadrangle was started this summer instead of the Poker Butte Quadrangle. This substitution was made to allow for examination of the Big Trails fault system, which runs through the east side of the Tallon Spring Quadrangle. As described in the last issue of *Wyoming Geo-notes* (page 40), evidence for strike/slip motion on this fault system could have far-reaching effects on the structural interpretation of at least three of the quadrangles in the area as well as on the overall southern Bighorn Mountains.

GOVERNOR'S SELENIUM WORK GROUP

by James C. Case, Geologic Hazards Division Head, Geological Survey of Wyoming.

In early June, Jim Case, Head of the Geologic Hazards Division, was appointed chairman of the Governor's Selenium Work Group. Mike Carnevale, the previous chairman, resigned from the position when he transferred from the Wyoming Department of Environmental Quality to a new position with the Wyoming Water Development Commission.

The Governor's Selenium Work Group is tasked with investigating selenium in Wyoming. The Work Group is composed of members that have volunteered their time and expertise in order to achieve a series of goals, which are listed below.

Selenium Work Group Goals

- 1) Coordinate selenium-related research in Wyoming
- 2) Determine the current state of knowledge regarding selenium
- 3) Identify gaps in understanding selenium
- 4) Identify research or information that is needed to reach a desirable state of knowledge regarding selenium
- 5) Increase public knowledge of selenium

In the process of satisfying the goals, the Work Group will assemble a network of knowledgeable selenium researchers and resource managers as well as informed members of the public. Members of the network will then be available to provide timely and effective responses to selenium questions, concerns, and problems if any arise.

In order to achieve the goals of the Work Group with minimal funding, a series of subcommittees were formed. Each subcommittee is composed of members with interests and expertise in a particular subject or group of related subjects. The subcommittees are responsible for generating and coordinating research, conducting literature reviews, and preparing state-of-knowledge papers for their areas of interest. Subcommittees were formed for the following areas of interest: Agricultural Management, Analytical Procedures, Fish and Wildlife, Geology/Geochemistry/Sampling Design, Information Dissemination/Agricultural Extension Coordination, Livestock/Domestic Animals, Human Health, Mining/Reclamation, Soil and Plant Science, and Water.

Meetings of the Work Group and subcommittees will be held at various locations around the State, and public participation will be encouraged. In areas where field research is being conducted, public tours of the study areas will be considered. In fact, on June 2, 1988, there was a selenium-related tour of the Casper-Alcova Irriga-

tion District west of Casper. Areas of ongoing selenium research were viewed, and aspects of selenium and its relationship to the environment were discussed. Over 60 persons attended the tour.

Many of the geological formations and soils in portions of the Casper-Alcova Irrigation District have a selenium component. A point made repeatedly throughout the tour, however, was that the mere presence of selenium does not mean that a problem exists. A few areas where elevated levels of selenium have been documented in soils, water, fish, and waterfowl were visited and discussed. In those instances, mitigative measures were also discussed.

Additional information on the Governor's Selenium Work Group and its subcommittees can be obtained from Jim Case at the Geological Survey of Wyoming, P.O. Box 3008, University Station, Laramie, Wyoming 82071-3008.

New preliminary geologic maps in the southern Bighorn Mountains, west of Kaycee

(see opposite page)

Preliminary geologic map of the Mayoworth Quadrangle, Johnson County, Wyoming - Open File Report 87-4

Preliminary geologic map of the Red Fork Powder River Quadrangle, Johnson County, Wyoming - Open File Report 87-5

Preliminary geologic map of the Fraker Mountain Quadrangle, Johnson County, Wyoming - Open File Report 88-4

Preliminary geologic map of the Barnum Quadrangle, Johnson County, Wyoming - Open File Report 88-5

Preliminary geologic map of the Tabletop Quadrangle, Washakie and Johnson Counties, Wyoming - Open File Report 88-6

These five maps are available from the Geological Survey of Wyoming. Cost of each map is \$3.50 over-the-counter and \$4.50 mailed first class.

Recent and new publications by the Geological Survey of Wyoming

Traveler's guide to the geology of Wyoming (2nd edition), D.L. Blackstone, Jr., Bulletin 67, 1988, (\$5.00).

*Reconnaissance geologic map of the Halls Meadow Springs Quadrangle, Fremont and Sublette Counties, Wyoming, W.D. Hausel, Open File Report 88-8, 1988, (\$3.50).

*Ongoing studies on the geology of Wyoming, P.L. Greer and A.J. VerPloeg, Open File Report 88-9, 1988, (\$3.50).

*Fluorite in Wyoming, R.E. Harris and J.K. King, Open File Report 88-10, 1988, (\$2.50).

*Stream-sediment sample results in search of kimberlite intrusives in southeastern Wyoming, W.D. Hausel, W.M. Sutherland, and E.B. Gregory, Open File Report 88-11, 1988, (\$12.00).

The Plumbago Creek silica sand deposit, Albany County, Wyoming, R.E. Harris, Report of Investigations 40, 1988, (\$4.00).

*Analyses and measured sections of seven coal samples from the Rock Springs district, Green River Basin coal field, southwestern Wyoming, G.B. Glass and J.T. Roberts, Report of Investigations 41, 1988, (\$4.00).

*Cassa silica rock deposit, Platte County, Wyoming, R.E. Harris, Report of Investigations 42, 1988, (\$4.00).

*Geologic road log of part of the Gros Ventre River valley including the Lower Gros Ventre Slide, J.D. Love and J.M. Love, Reprint 46, 1988, (\$6.00).

* New releases since the last issue of *Wyoming Geo-notes*.

Order these and other publications from: Geological Survey of Wyoming, Box 3008, University Station, Laramie, Wyoming 82071-3008. Phone: (307) 766-2286. Many of these publications are also available over-the-counter at the Wyoming Oil and Gas Conservation Commission (Basko Building) in Casper, Wyoming.

Add \$1.00 for each \$5.00 of purchase price if mailed First Class (\$1.00 minimum). Add an additional \$1.50 for maps mailed rolled.

