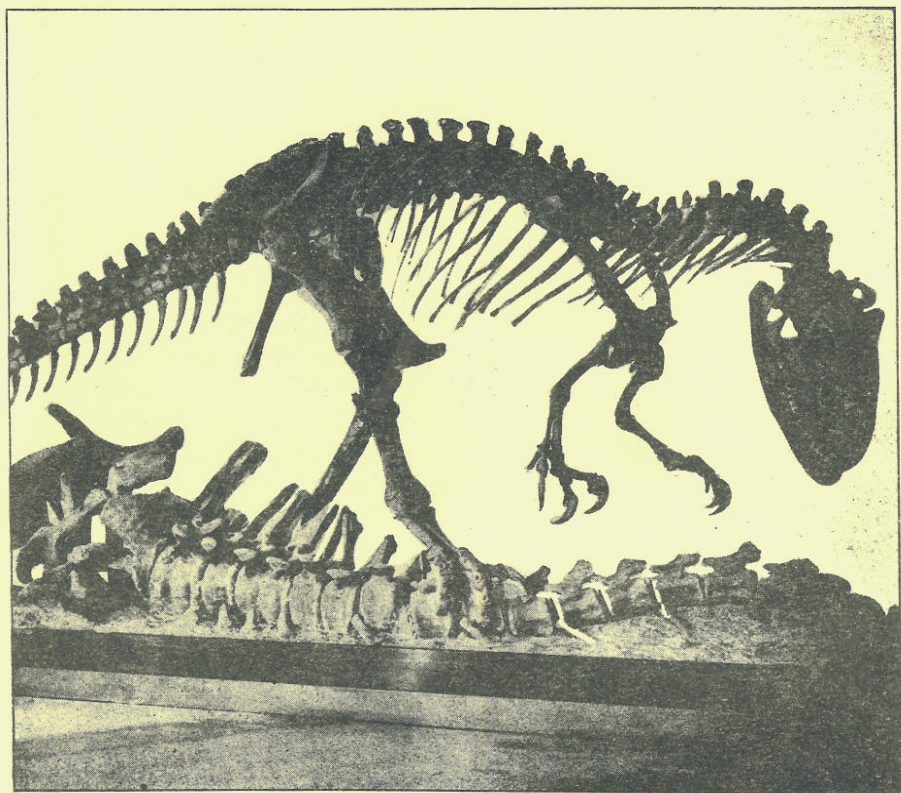


THE GEOLOGICAL SURVEY OF WYOMING
Gary B. Glass, State Geologist

WYOMING GEO-NOTES
NO. 32



LARAMIE, WYOMING
November, 1991

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 \$7.00) or as single copies at \$2.00 each. Two-year subscriptions are accepted.



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Cover: A skeleton of the dinosaur, *Allosaurus* (from Smithsonian Institution, U.S. National Museum Bulletin 110, plate 16, 1920). An articulated skeleton of a sub-adult *Allosaurus* was recently recovered from a site northeast of Greybull (p. 40 to 41).

The Geological Survey of Wyoming
P.O. Box 3008, University Station
Laramie, Wyoming 82071-3008
(307) 766-2286
FAX (307) 766-2605

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MINERALS UPDATE

OVERVIEW

By Gary B. Glass, State Geologist

The third quarter of 1991 was marked by continuing low prices for Wyoming crude oil (averaging about \$16.00-16.50 per barrel for the quarter) and no more than a 15 cent increase in the spot sale price for natural gas at Opal. Based on these and previous observations, the average prices for Wyoming crude oil and natural gas for 1991 are estimated at \$17.21 and \$1.30, respectively (Table 1). There is a chance that natural gas prices could improve if there is an early and cold winter.

While oil production continues its expected decline, production of natural gas is still increasing, but at a slackened pace (Figures 1 and 2, p. 5 and 6; Table 2). This slower rate of growth for natural gas is a function of excess production capacity in a weak market. There will be increases in production when the Kern River Pipeline is completed, but not all the production going into the line is new production. In some cases, existing production will simply be shifted over to the new pipeline. And the proposed Altamont pipeline from Canada looks like it may carry mostly Canadian gas.

Table 1. AVERAGE PRICE PAID FOR WYOMING OIL, NATURAL GAS, COAL, TRONA, AND URANIUM, FORECAST TO 1995¹.

Calendar Year	Oil ²	Natural Gas ³	Coal ⁴	Trona ⁵	Uranium ⁶
*1985	23.61	3.03	11.35	35.18	36.82
*1986	13.10	2.51	10.71	34.80	52.45
*1987	16.50	2.02	9.54	36.56	43.55
*1988	13.41	1.74	9.09	36.88	25.77
*1989	16.64	1.64	8.63	40.76	22.09
*1990	22.10	1.63	8.31	41.86	21.16
1991	17.21	1.30	7.97	45.00	21.00
1992	17.21	1.44	7.70	46.00	21.00
1993	17.21	1.60	7.47	47.00	21.00
1994	17.21	1.76	7.26	48.00	21.00
1995	17.21	1.92	7.08	49.00	21.00

* Actual value for comparison.

¹ Modified from Consensus Revenue Estimating Group, Wyoming State Government Revenue Forecast FY91-FY95, October, 1991, 21 p.

² First purchase price in dollars per barrel.

³ Wellhead price in dollars per MCF (includes carbon dioxide).

⁴ Dollars per short ton (weighted average price for coal mined by surface and underground methods).

⁵ Dollars per ton of trona, not soda ash.

⁶ Uranium prices are all estimated by the Geological Survey of Wyoming (October, 1991); in dollars per pound of yellowcake (weighted average price for in-situ and surface-mined uranium).

Table 2. WYOMING MINERAL PRODUCTION, FORECAST TO 1995¹.

Calendar Year	Oil ²	Methane ³	Carbon Dioxide ³	Helium ⁴	Coal ⁵	Trona ⁵	Mined Uranium ⁶	In-situ Uranium ⁷	Sulfur ⁸
*1981	122.1	408.4	—	—	102.8	11.8	4.6	—	0.05
*1982	118.7	424.7	—	—	107.9	10.1	2.1	—	0.07
*1983	120.9	444.0	—	—	112.2	10.5	3.0	—	0.57
*1984	127.8	516.7	—	—	130.7	11.0	1.6	—	0.71
*1985	131.0	416.6	—	—	140.4	10.8	0.6	—	0.80
*1986	122.4	403.3	23.8	0.15	136.3	11.9	0.2	0.04	0.76
*1987	115.9	498.0	114.2	0.86	146.5	12.4	0.2	0.06	1.19
*1988	114.3	509.1	110.0	0.83	163.6	14.9	0.3	1.16	1.06
*1989	109.1	587.4	126.1	0.94	171.1	16.2	0.1	1.07	1.17
*1990	104.0	681.4	131.0	0.98	184.0	16.2	0.2	1.1	0.91
1991	101.5	728.0	131.0	0.98	193.4	16.2	0.3	1.1	1.00
1992	99.5	787.0	131.0	0.98	203.1	16.3	0.4	1.6	1.00
1993	95.5	846.0	131.0	0.98	213.0	16.6	0.4	2.2	1.00
1994	91.7	905.0	131.0	0.98	223.7	17.2	0.4	2.5	1.00
1995	88.0	963.0	131.0	0.98	234.8	17.4	0.4	2.5	1.00

*Actual values for comparison; ¹Geological Survey of Wyoming, October, 1991; ²millions of barrels; ³billions of cubic feet; ⁴billions of cubic feet, based on Exxon's estimate that the average helium content in the gas processed at Shute Creek is 0.5 percent; ⁵millions of tons; ⁶millions of tons of uranium ore (not yellowcake); ⁷millions of pounds of yellowcake (U₃O₈), (unknown between 1981-1985 because it was reported only as taxable valuation; estimates for 1989-1994 are based on company information); ⁸millions of tons (prior to 1989, converted from gallons of sulfur produced at gas processing plants as reported to the Wyoming Oil and Gas Conservation Commission).

The daily rig count averaged by month also points up the slowing pace of Wyoming's oil and gas industry (Figure 3, p. 7). Unlike the last five years, the monthly average has not reached 40 yet this year.

Also, the weak gas market is cited as the reason that Louisiana Land and Exploration has postponed building a gas plant at the Madden Field. The \$50 million plant was announced in the first quarter of the year and was to be completed in 1992 (*Wyoming Geo-notes No. 30*, p. 14).

There are also some significant changes in what are shown as the historical and forecast production of methane and carbon dioxide in Table 2. In past versions of this table, certain other gases were incorrectly included in the methane column. For example, gas recovered after recycling is no longer counted as produced gas. Volumes of other non-hydrocarbon gases have also been subtracted. In regard to carbon dioxide, forecast production is somewhat greater than previous estimates. As before, however, the carbon dioxide production shown in Table 2 includes both marketed and vented gas.

Coal production is heading for another record year. It is likely to increase five percent or more in 1991, and it should continue to grow at five percent a year through 1995 (Table 2). This means that annual coal production from Wyoming

should top 203 million tons by 1992. The average price for a ton of Wyoming coal, however, continues to decline because of the low spot sale price (Table 1). In 1991, low cost coal (under \$5.00 per ton) will account for 31 percent of the statewide production; by 1995, it will account for 51 percent (Table 6, p. 19).

Despite the low spot sale price for Wyoming coal from the Powder River Coal Field, there is renewed interest in leasing Federal coal for at least one new mine and for the maintenance of a number of existing mines. Federal coal lease applications for the Powder River Coal Field currently exceed one billion tons of reserves.

Trona production is not expected to increase significantly between 1990 and 1991, but modest growth is expected after 1992 (Table 2). Trona prices are also expected to increase slightly over the next five years (Table 1).

Estimates of uranium prices and production from Wyoming were scaled down for this third-quarter report (Tables 1 and 2). The concern that Russia might flood the market with stockpiled uranium may have lessened for awhile at least as that country struggles with change.

Table 3 is a production history for many other minerals and materials produced in Wyoming. Of these, production of bentonite and possibly decorative stone may show increases in 1991. The other commodities in Table 3 will likely show little change at all from 1990.

Table 3. PRODUCTION HISTORY OF SELECTED WYOMING MINERAL COMMODITIES¹.

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Bentonite ²	2.35	2.18	3.08	2.59	1.82	2.16	2.32	2.22 ⁶	2.43 ⁶
Clay ⁴	15.7	36.4	59.6	35.9	23.2	1.31	61.1	23.6 ¹	NA
Decorative Stone ²	0.05	0.07	0.08	0.09	0.07	0.06	0.07 ⁷	0.06 ⁶	0.06 ⁶
Dolomite ²	0.61	0.66	0.86	0.87	0.81	0.46	0.19 ⁶	0.15 ⁶	0.21 ⁶
Feldspar ⁴	0.17	----	----	----	----	----	----	2.0 ¹	NA
Gypsum ²	0.26	0.33	0.33	0.35	0.41	0.35	0.40 ⁷	0.20 ⁶	0.44 ⁶
Iron Ore ²	3.28	2.48	----	----	----	----	----	minor ⁸	minor ⁸
Leonardite ⁴	----	----	----	----	----	----	----	----	41.7 ^{1,6}
Limestone ^{2,5}	0.59	0.56	0.65	0.32	0.33	0.32	0.64	0.60 ⁶	1.37 ⁶
Sand and Gravel ^{2,3}	6.24	6.72	8.31	6.40	5.01	4.12	3.15	6.46 ⁶	6.11 ⁶
Shale ⁴	----	----	20.3	14.7	9.88	49.0	50.2 ⁶	1.8 ¹	43.5 ^{1,6}
Sodium Sulfate ⁴	3.17	3.19	3.25	2.71	2.03	----	2.10 ⁶	3.2 ¹	1.9 ^{1,6}

Sources: ¹Ad Valorem Tax Division, unless otherwise noted. ²Millions of short tons. ³Includes ballast, scoria, and limestone used for aggregate. ⁴Thousands of short tons. ⁵Includes limestone used for cement rock, sugar beet refining, and other uses. ⁶Wyoming State Inspector of Mines. ⁷Estimated by Geological Survey of Wyoming. ⁸Less than 1,000 tons of iron ore were sold for pigment. Prepared by Geological Survey of Wyoming, July, 1991.

OIL AND GAS UPDATE

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

In early October, Amoco Oil Company announced the closing of its Casper refinery. The closing in December, 1991, will eliminate 210 refinery jobs in Casper. While the refinery's capacity is 40,000 barrels of crude oil per day, it has recently only been processing about 28,000 barrels. The company's reasons for the closure included a \$150 million capital investment needed for environmental projects, the small size of the refinery, and a decreasing supply of high-quality crude oil. Over the past few years, a larger portion of Wyoming's production has been high-sulfur or low-gravity crude oil which the Amoco refinery could not process. As recently as 10 years ago, Wyoming had nine operating refineries. Only four operating refineries will remain in Wyoming after the Amoco closure.

In a related item, Wainoco Oil Company purchased the Frontier Oil refinery in Cheyenne for \$50 million. The refinery processes about 38,000 barrels of crude oil per day and can process lower quality crude oil. The sale is not expected to affect the 200 workers at the refinery.

KN Energy took over operation of the Douglas gas plant, which processes gas from Campbell and Converse counties. The plant ties into KN Energy's interstate pipeline system. Phillips 66 Natural Gas, the former operator of the plant, received a KN Energy gathering system in Oklahoma and cash in the exchange.

BWAB acquired Chevron's interests in the Amos Draw and Andy fields. The fields produce oil and gas from the Muddy Sandstone. The transaction included interests in three operating and 18 inactive wells, plus about 1,000 undeveloped acres. The two fields have produced over three million barrels of oil and over 64 billion cubic feet of gas since their discovery in the early 1980s.

In another transaction, Equitable Resources purchased Maxus Energy's Rocky Mountain area oil and gas properties in Wyoming, Montana, North Dakota, and Utah. Maxus will still operate Alpha Field in the Powder River Basin, but decided to sell its other Rocky Mountain properties. Maxus will now focus their efforts on the Gulf of Mexico and the Texas Panhandle.

Kern River Gas Transmission Co. will add pipeline and compression facilities that will bring 220 million cubic feet of gas per day from Amoco's Whitney Canyon and Chevron's Carter Creek gas processing plants and 118 million cubic feet of gas per day from Amoco's Painter Reservoir gas plant. The \$22.3 million project requires 13 miles of 20-inch pipeline, 0.5 mile of 12-inch pipeline, and 7,200 horsepower of compression.

Altamont Gas Transmission Company has ordered over \$200 million worth of pipe. The 620-mile natural gas pipeline will bring natural gas from Canada to

Opal, Wyoming, where it will connect with the Kern River pipeline. The Federal Energy Regulatory Commission granted final certification for the pipeline in early September.

The Interior Board of Land Appeals ruled that the U.S. Bureau of Land Management (BLM) may permit the drilling of additional exploratory wells after a discovery well is drilled to confirm and define the discovery. Exploratory wells on Federal lands generally only require an environmental assessment rather than an environmental impact statement. It was also determined that exploration tests for coalbed methane would require environmental assessments on a project by project basis.

Production statistics for Wyoming show that nearly 104 million barrels of oil and 812.4 billion cubic feet of gas were produced in 1990 (Figures 1 and 2). Additionally, oil and gas operators produced nearly one billion cubic feet of helium and over 912,000 tons of sulfur at gas processing plants.

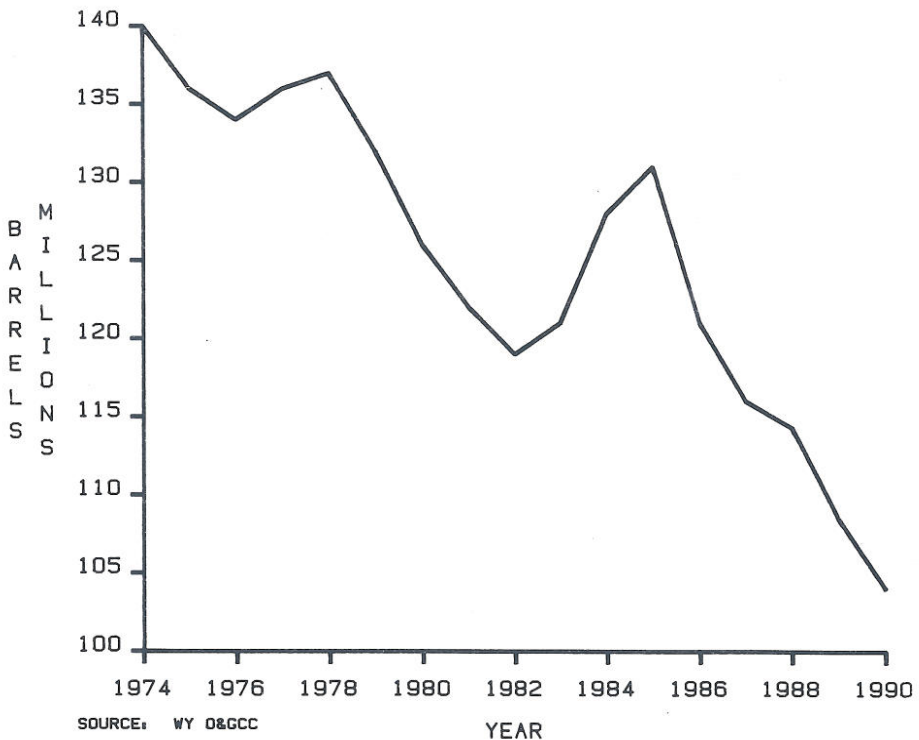


Figure 1. ANNUAL CRUDE OIL PRODUCTION FROM WYOMING (1974 TO 1990).

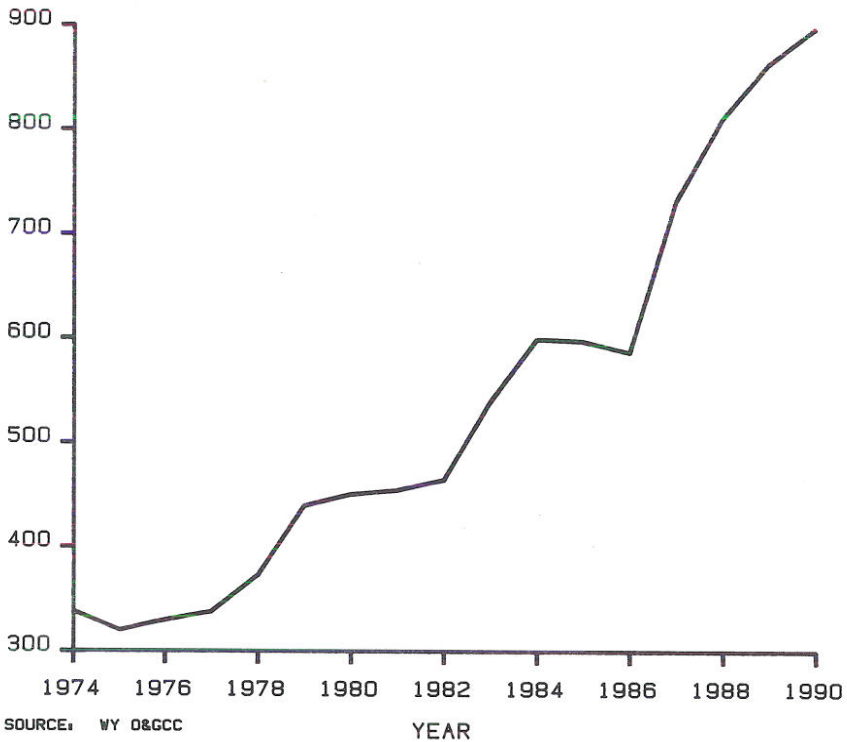


Figure 2. ANNUAL PRODUCTION OF NATURAL GAS FROM WYOMING (1974 to 1990).

The average daily rig count for September, 1991, was only 32 (Figure 3), and this was the lowest average for a September since 1985. The average daily rig count so far this year is also lower than for previous years. This is not all that surprising since Wyoming producers on the average are currently receiving less than \$17.00 a barrel for crude oil (Figure 4) and since the spot price for natural gas has been less than \$1.10 for most of the year (Figure 5).

Despite the slump in drilling, lease sales in the State did fairly well during the third quarter of this year although total revenue has dropped off somewhat compared to the total revenue from sales held during the third quarter of 1990 (Table 4). The high per-acre bid at the State Land and Farm Loan Office's July sale was only \$70. M.J. Kennedy made the high bid for a 640-acre tract that covers section 16, T32N, R69W. The tract is just west of Shawnee, which that produces oil and gas from the White River, Niobrara, and Frontier formations. Yates Petroleum had the high bid on 32 other tracts at this sale.

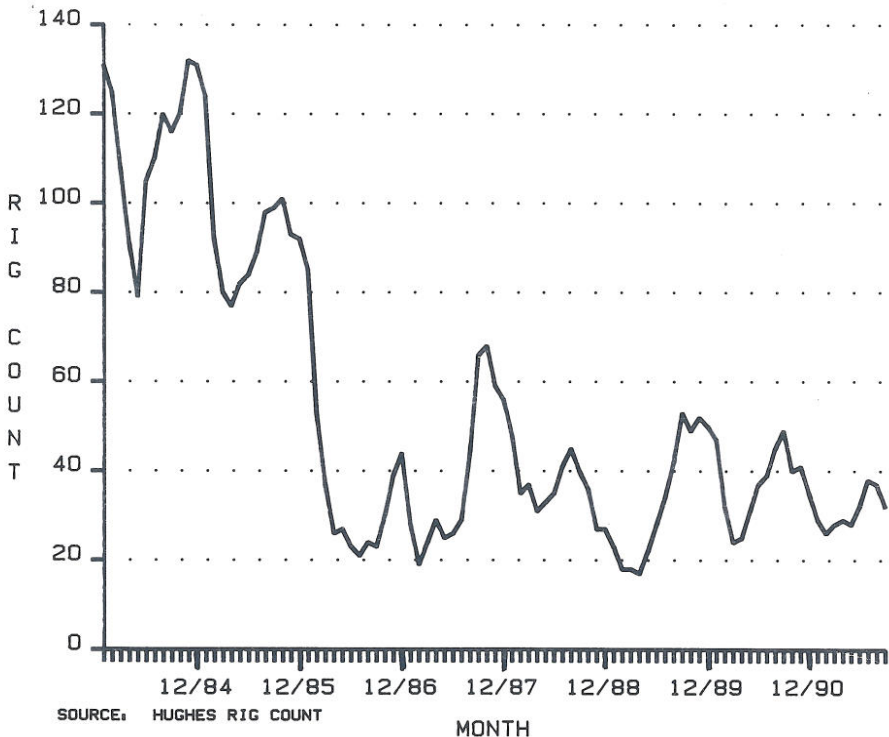


Figure 3. WYOMING DAILY RIG COUNT AVERAGED BY MONTH (1984 to PRESENT).

The high per-acre bid at the State Land and Farm Loan Office's September sale was \$260 by James Tack for six mineral acres in S/2 NE section 17, T50N, R71W. The tract is two miles west of Minnelusa oil production at Superhornet Field. Steve Tofte paid \$122 per acre for a 640-acre lease that covers section 36, T50N, R69W. This lease is less than a mile southeast of Minnelusa oil production at Right A Way Field.

The high per-acre bid at the U.S. Bureau of Land Management's (BLM's) August sale was \$325 by Lario Oil and Gas for a 40.63-acre tract that covers SE SW section 13, T47N, R72W. The lease is on the south end of Breen Field, which produces from the Mowry Shale, the Muddy Sandstone, and the Minnelusa Formation. The sale's second highest per-acre bid of \$300 was made by Marathon Oil Co. for a 317.08-acre lease in the E/2 section 30, T37N, R75W. The lease is a mile north of Frontier Formation and Muddy Sandstone production on the north end of Sand Dunes Field. Maurice W. Brown had the sale's third highest

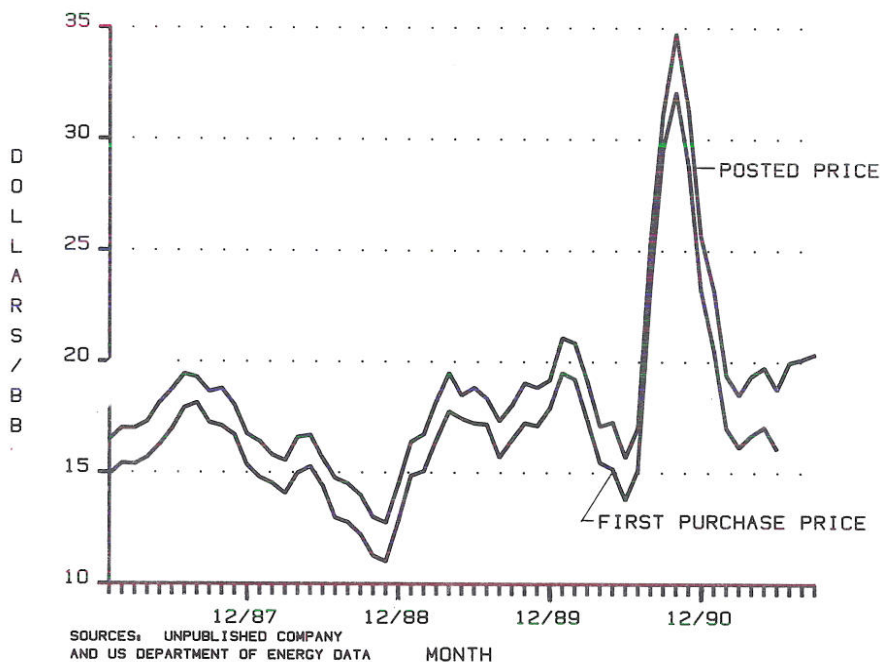


Figure 4. WYOMING CRUDE OIL PRICES AVERAGED BY MONTH (1987 to PRESENT).

per-acre bid of \$225 for an 80-acre parcel that covers S/2 NE section 35, T51N, R71W. The parcel is near an abandoned Muddy Sandstone producer on the southeastern edge of Springen Ranch Field. In all, ten parcels received bids of \$100 or more at this sale.

Exploration and Development

Company data and information compiled and published by Petroleum Information indicate the following significant exploration and development events occurred in Wyoming during the third quarter of 1991. Activities related to horizontal drilling and coalbed methane are discussed in separate sections. The letters preceding discussions below refer to locations on Figure 6.

A. Chevron USA has an **apparent new discovery in the Overthrust Belt**. The 1-11 Chevron well in SE SW section 11, T14N, R120W encountered 400 feet of pay in the Nugget Sandstone. There were exceptional shows of hydrocarbons in 300 feet of the pay zone. Chevron set production casing to 16,098 feet which may establish the Nugget in this well as the deepest Nugget production in the Overthrust Belt. The new discovery is about one mile southeast of Nugget gas and condensate production at Glasscock Hollow Field.

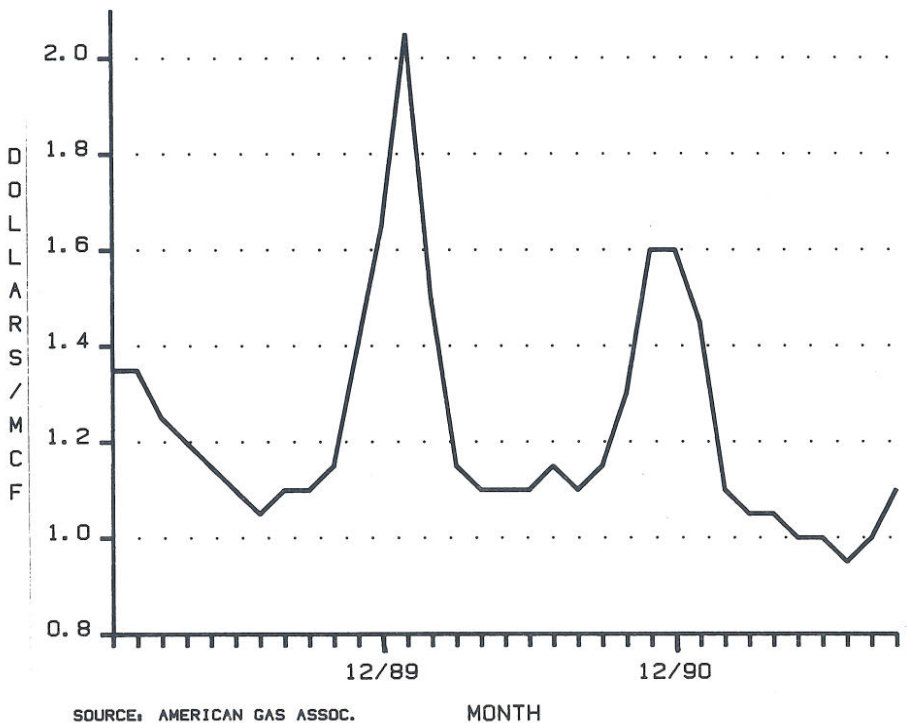


Figure 5. SPOT GAS PRICES AT OPAL, WYOMING, AVERAGED BY MONTH (1989 TO PRESENT).

B. Amoco Production recompleted the 1 Champlin 505 Amoco B well in NE SW section 3, T18N, R120W as a discovery in the Madison Limestone. The well flowed 1.9 million cubic feet of gas, 28 barrels of condensate, and seven barrels of water per day. Amoco originally completed the well in 1982 in the Bighorn Dolomite to open Session Mountain Field. The well has produced 266 million cubic feet of gas and 4,267 barrels of condensate in six months of production since recompletion.

C. Chevron USA plans to drill a 3,000-foot stratigraphic test to evaluate the Hilliard Shale in NE SW section 34, T24N, R116W.

D. Bruff Field has three new gas wells. Wexpro completed their 10-2 Mountain Fuel-Fee well in NW SE section 10, T19N, R112W for 4.4 million cubic feet of gas, 13 barrels of condensate, and 13 barrels of water per day from the Dakota. Texaco completed their 2 A.M. Tripp NCT-1 well in NE SE section 14, T19N, R112W for 3.1 million cubic feet of gas per day from the Frontier. Texaco also completed their 2 State of Wyoming UNCT-1 in the W/2 NW section 24, T19N, R112W for 2.2 million cubic feet of gas and 57 barrels of water per day from the Frontier.

Table 4. FEDERAL AND STATE COMPETITIVE OIL AND GAS LEASE SALES IN WYOMING.

BLM SALES							STATE SALES								
Month	Total Revenue	Number of parcels offered	Number of parcels leased	Total acres	Acres leased	Average price per acre leased	High price per acre	Month	Total Revenue	Number of parcels offered	Number of parcels leased	Total acres	Acres leased	Average price per acre leased	High price per acre
1987							1987								
TOTAL	\$15,724,159	727	646	197,422	177,960	\$88.36	\$6,555.00	TOTAL	\$2,526,567	1,200	579	511,638	244,740	\$10.32	\$2,300.00
1988							1988								
TOTAL	\$27,688,861	4,119	1,581	4,412,513	1,350,897	\$20.50	\$6,500.00	TOTAL	\$6,202,724	1,200	873	445,953	331,943	\$18.69	\$465.00
1989							1989								
TOTAL	\$15,832,105	4,286	1,360	4,028,750	972,403	\$16.28	\$3,000.00	TOTAL	\$3,123,984	1,199	792	461,852	311,274	\$10.04	\$540.00
1990							1990								
February	\$3,301,479	524	259	335,275	141,555	\$23.32	\$340.00	January	\$190,921	200	100	74,987	38,884	\$4.91	\$46.00
April	\$2,163,988	513	218	399,790	138,909	\$15.58	\$275.00	March	\$688,262	200	132	79,405	54,193	\$12.33	\$85.00
June	\$3,480,557	511	315	305,550	172,798	\$20.14	\$240.00	May	\$690,310	199	146	79,667	60,986	\$11.32	\$270.00
August	\$2,892,191	533	251	493,185	187,259	\$15.44	\$325.00	July	\$521,824	200	154	78,507	62,999	\$8.28	\$60.00
October	\$2,580,072	423	285	255,886	141,707	\$18.21	\$200.00	September	\$1,472,248	200	200	80,197	80,197	\$18.75	\$240.00
December	\$3,578,846	467	285	379,452	185,065	\$19.34	\$260.00	November	\$1,435,529	200	192	85,335	83,133	\$17.27	\$265.00
TOTAL	\$17,987,133	2,971	1,593	2,169,138	967,293	\$18.61	\$340.00	TOTAL	\$4,979,094	1,199	732	478,088	380,382	\$13.09	\$270.00
1991							1991								
February	\$4,333,661	370	200	275,600	122,225	\$35.46	\$16,000.00	January	\$2,050,868	300	295	117,677	115,998	\$17.68	\$401.00
April	\$1,890,742	470	217	332,764	132,278	\$14.22	\$170.00	March	\$642,191	197	170	69,652	62,226	\$10.32	\$110.00
June	\$2,002,440	490	176	430,576	120,992	\$16.55	\$275.00	May	\$539,556	199	173	79,156	70,081	\$7.70	\$77.00
August	\$2,005,511	557	211	472,103	120,292	\$16.67	\$325.00	July	\$396,569	200	124	73,179	52,850	\$7.50	\$70.00
TOTAL	\$10,235,354	1,937	804	1,581,544	518,812	\$16.61	\$275.00	September	411,971	200	146	69,025	59,908	\$8.09	\$260.00

Sources: State Land and Farm Loan Office, Petroleum Information Corporation - Rocky Mountain Region Report, and U.S. Bureau of Land Management.

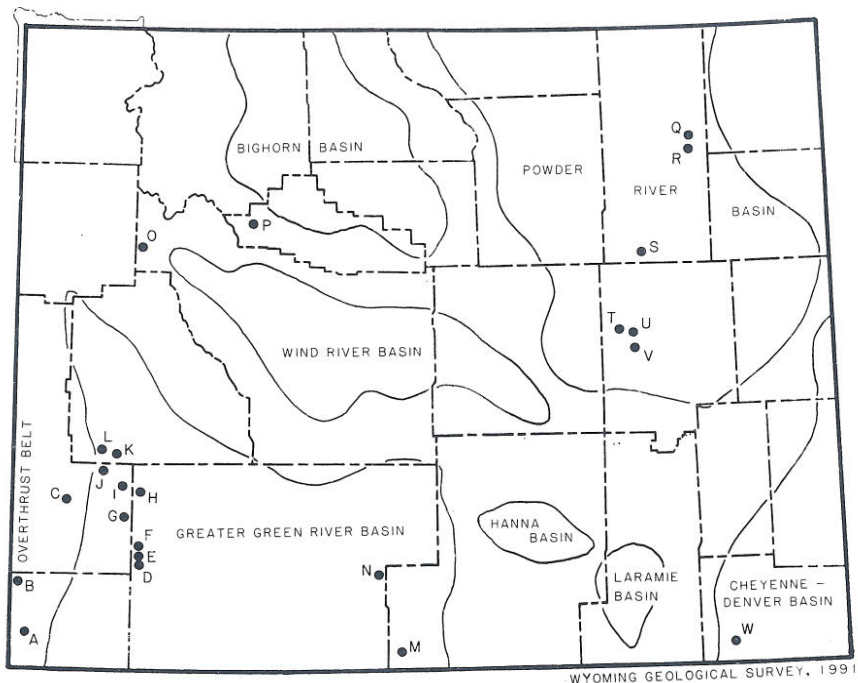


Figure 6. OIL AND GAS EXPLORATION AND DEVELOPMENT ACTIVITY IN WYOMING DURING THE THIRD QUARTER OF 1991.

E. Washington Energy and Exploration dually completed their 30-26 Sagebrush-Federal well in C SE section 26, T20N, R112W for 7.6 million cubic feet of gas per day from the Frontier and 1.3 million cubic feet of gas per day from the Dakota. The well is in Fabian Ditch Field on the Moxa arch.

F. Amoco Production completed three new gas wells in Seven Mile Gulch Field on the Moxa arch. The 17 Seven Mile Gulch Unit well in C NE section 16, T20N, R112W flowed 2.8 million cubic feet of gas and five barrels of water from the Frontier. The 18 Seven Mile Gulch Unit well in NE SW section 23, T20N, R112 flowed 7.6 million cubic feet of gas, 66 barrels of condensate, and 10 barrels of water per day from the Dakota. The 19 Seven Mile Gulch Unit well in NW SW section 24, T20N, R112W flowed 2.3 million cubic feet of gas, eight barrels of condensate, and four barrels of water per day from the Dakota.

G. Amoco Production completed a new Frontier producer in Cow Hollow Field. The 11 Cow Hollow Unit well in NE NE section 33, T23N, R112W flowed 2.6 million cubic feet of gas, 14 barrels of condensate, and 41 barrels of water per day.

H. Lincoln Road Field has three new gas wells. Texaco's 3 Government-C.E. Brehm well in SE SW section 4, T24N, R111W flowed 3.5 million cubic feet of gas, 65 barrels of condensate, and 240 barrels of water per day from the Dakota. Washington Energy and Exploration completed two new wells. The 30-10 Lincoln Road well in SW SE Section 10, T24N, R111W flowed 5.9 million cubic feet of gas, 44 barrels of condensate, and two barrels of water per day from the Dakota. The 20-5 Lincoln Road well in NE section 5, T24N, R111W flowed 1.5 million feet of gas, two barrels of condensate, and 13 barrels of water from the Frontier.

I. Texaco completed a new producer in Fontenelle Field. The 30-11 WSA-West Swan Unit well in NE SW section 30, T25N, R111W flowed 2.5 million cubic feet of gas and two barrels of condensate per day from the Frontier.

J. Enron Oil and Gas completed a new well in Green River Bend Field. Their 149-10 Green River Bend Unit well in SE NE section 10, T26N, R113W flowed 2.3 million cubic feet of gas and five barrels of water per day from the Frontier.

K. Enron also completed a new well in Figure Four Canyon Field. Their 13-10 Figure Four Canyon Unit well in SW SE section 10, T27N, R112W flowed 799,000 cubic feet of gas per day from the Frontier Formation.

L. Chevron USA completed two new gas wells in Birch Creek Field. The 133 Birch Creek Unit well in SW SE section 15, T27N, R113W flowed 10 million cubic feet of gas and two barrels of condensate per day from the Frontier. The 118 Birch Creek Unit well in NW NE section 2, T27N, R113W flowed 1.0 million cubic feet of gas per day. Production from the Frontier and Bear River formations is comingled at this well.

M. Gasco discovered gas at a wildcat on the southeastern flank of the Greater Green River Basin. Their 8-8 Pronghorn well in SE NW section 8, T13N, R92W flowed 730,000 cubic feet of gas and five barrels of condensate per day from the Ericson Sandstone. The well is about two miles south of shut-in Mesaverde and Lewis gas production in Robbers Gulch Field.

N. Amoco Production also reported an Ericson Sandstone discovery near Wamsutter. The 3 Frewen Deep Unit well in W/2 SW section 7, T19N, R94W flowed 884,000 cubic feet of gas, 38 barrels of condensate, and five barrels of water per day.

O. Conoco announced plans to drill a 15,000-foot test of the Madison Limestone in NW SW section 36, T43N, R110W. The test is about 18 miles west of Dubois Field, which produces from the Phosphoria Formation. Exxon's Sohare Field, a shut-in Frontier Formation and Muddy Sandstone discovery, is about 15 miles east of the planned test.

P. BWAB also announced plans to test the Madison at a 3,500-foot test on the southwestern flank of the Bighorn Basin in NE NE section 23, T44N, R102W. The nearest production was in the Phosphoria Formation at Dickie Field, about eight miles to the northeast.

Q. Pacific Enterprises Oil is completing a Minnelusa Formation well in the Powder River Basin. Their 21-31 Tanner-Federal well in NE NW section 31, T51N, R70W is expected to produce between 300 and 400 barrels of oil per day. The well offsets Pacific's 24-30 Tanner-Federal discovery well in SE SW section 30, T51N, R70W, which was completed for 580 barrels of oil per day from the Minnelusa. The company plans to drill southwest and west offsets to the discovery well.

R. Apache Corp. completed a new Minnelusa oil well in Rainbow Ranch North Field. The 10 North Rainbow Ranch Unit well in SE SW section 24, T49N, R71W pumped oil at the rate of 500 barrels per day.

S. Buck Draw North Field has two new Dakota producers. Kerr-McGee completed the 13-17 NBDU well in NW SW section 17, T41N, R73W for 958 barrels of oil and 2.0 million cubic feet of gas per day. Kerr-McGee also completed the 13-18 NBDU well in NW SW section 18, T41N, R73W for 736 barrels of oil, 1.5 million cubic feet of gas, and three barrels of water per day.

T. Marathon Oil produced an average of 1,204 barrels of oil per day from the Muddy Sandstone at their 10-15 Sand Trap well in SE NE section 15, T36N, R76W. The well is about one mile south of the Blue Hill Field discovery well completed in 1988 by Chevron USA. The discovery well produces oil from the Frontier Formation.

U. Enhanced oil recovery operations at Sand Dunes Field began in August when 40 million cubic feet of gas per day were injected into the Muddy Sandstone. Peak oil production is expected to reach 12,000 barrels per day at the unit, which is operated by Kerr-McGee.

V. W.A. Moncrief Jr. completed an offset well in Popskull Field. The 28-2 Popskull Unit well in NW NE section 28, T35N, R75W pumped 35 barrels of oil and 2,000 cubic feet of gas per day from the Muddy Sandstone.

W. Borie Field has a new oil producer. General Atlantic Resources completed the 13-24 Wyoming State well in NW SW Section 24, T13N, R68W for 165 barrels of oil per day on pump from two sands in the Muddy.

Horizontal Drilling

During the third quarter of 1991, the following significant activities related to horizontal drilling occurred. The letters preceding the discussions below refer to locations on Figure 7. The discussions are based on company data and on information compiled and published by Petroleum Information.

A. Davis Exploration has applied for permits to drill up to four horizontal Madison Limestone wells in Lite Butte Field. The company plans to redrill two existing vertical wells that produce from the Madison in NE NW section 2, T50N, R92W, and in NE SW section 35, T51N, R92W. The two new horizontal wells are planned in SE NE section 2, T50N, R92W, and in SE SW section 35, T51N, R92W.

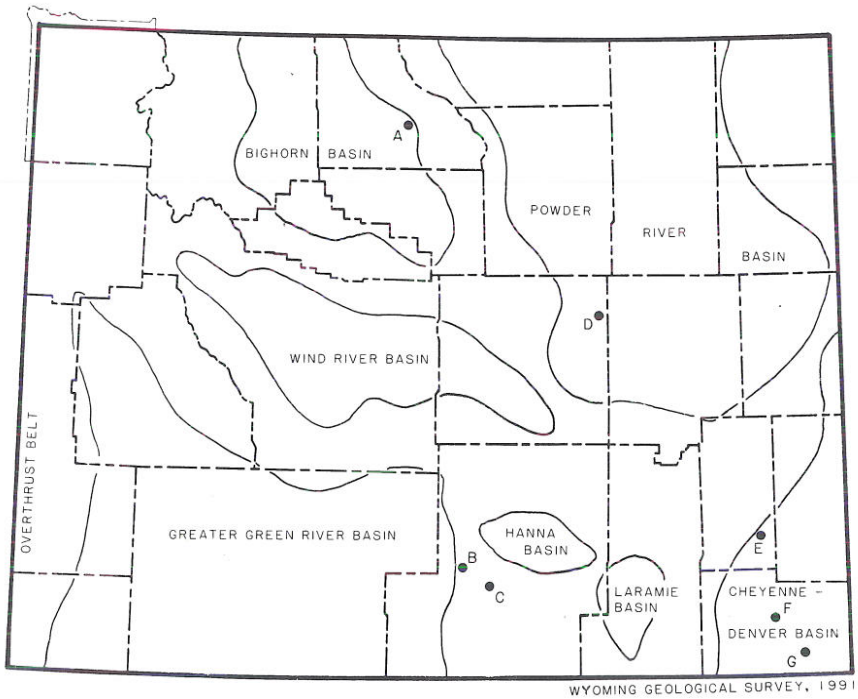


Figure 7. HORIZONTAL-DRILLING ACTIVITY IN WYOMING DURING THE THIRD QUARTER OF 1991.

B. Union Pacific Resources staked a location for a horizontal Niobrara test in SE SW Section 12, T20N, R88W. The nearest production is four miles south at Hatfield Field from the Dakota, Nugget, Phosphoria, and Tensleep.

C. Union Pacific Resources staked a location for another horizontal Niobrara test in NE SE section 20, T19N, R86W. The test is about two miles southeast of Hugus Field, which produced oil from the Steele and Niobrara.

D. GLG Energy completed their 32-6H Si Tanka well in SW SE section 31, T39N, R77W. The well produced 114 barrels of oil during 12 days in April and is now temporarily abandoned. The company has staked a location for another horizontal Niobrara test in NW NE section 3, T39N, R78W.

E. Presidio Exploration is drilling a horizontal Niobrara test in NW NW section 15, T23N, R66W. The test is just south of a non-commercial vertical Niobrara well completed in 1984. That well produced 262 barrels of oil before it was abandoned.

F. Snyder Oil released completion details on its 10-21 Hutton well in SW NW section 21, T16N, R64W. The Niobrara well in Silo Field had an initial potential

on pump of 100 barrels of oil, 5,000 cubic feet of gas, and 10 barrels of water per day. Chesapeake Operating staked a location in Silo Field for a horizontal Niobrara test in S/2 SW section 1, T15N, R65W.

G. EOG will test the Greenhorn Limestone with a horizontal reentry of a dry hole drilled by True Oil. The 14-16H Louth Well was spudded in SW SW section 16, T14N, R63W and will begin building a 500-foot radius curve at 7,500 feet.

Coalbed Methane

During the third quarter of 1991, the following significant activities related to coalbed methane occurred. The letters preceding the discussions below refer to locations on Figure 8. The discussions are based on company data and on information compiled and published by Petroleum Information.

A. Petroleum Inc. staked a location for their 6-36 State well in SE NW Section 36, T45N, R96W to test Mesaverde coals at 1,403 feet. This proposed well is in an area that the Geological Survey of Wyoming recently described coals with an apparent rank of subbituminous A (Taucher, Gregory, and Glass, 1990).

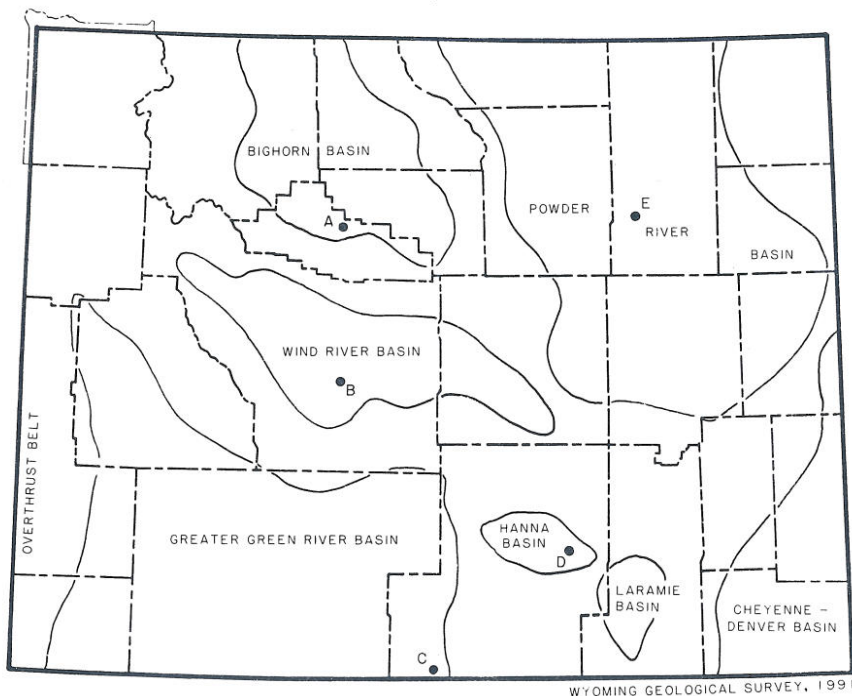


Figure 8. COALBED METHANE ACTIVITY IN WYOMING DURING THE THIRD QUARTER OF 1991.

B. At Riverton Dome Field, Arco recompleted an old well as a coalbed methane well in the Mesaverde in Riverton Dome Field. The well is in SE SE Section 25, T1S, R4E, and has produced over 24 million cubic feet of gas and over 20,000 barrels of water in six months of production. The U.S. Geological Survey reported good coalbed methane potential for this area (*Wyoming Geo-notes No. 31, p. 12*).

C. Fuel Resources Development is producing methane and water from 11 wells in Dixon Field. Production through June was nearly 37 million cubic feet of gas and nearly 1.9 million barrels of water.

D. Metfuel is still dewatering their two coalbed methane wells in the Hanna Formation in sections 3 and 11, T23N, R81W. The two wells produced 291,000 cubic feet of gas and over 214,000 barrels of water during the first six months of 1991.

E. Exxon has announced tentative plans to drill several coalbed methane wells in the Fort Union Formation at Hartzog Draw Field. No other details are available.

Reference cited

Taucher, P.J., Gregory, R.W., and Glass, G.B., 1990, Results of coal drilling projects in the Bighorn Basin, Wyoming: Geological Survey of Wyoming Report of Investigations 43, 247 p.

COAL UPDATE

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

Wyoming coal production for 1991 is apparently headed for another record. Coal deliveries for the first half of this year were about 5.5 million tons (or 6.5 percent) ahead of those recorded for the first half of last year (Table 5 and Figure 9). If the percentage increase in production from 1990 to 1991 is the predicted five percent, year-end production will be about 193.2 million tons (Table 6). Coal production in the Powder River Coal Field (Campbell, Converse, and Sheridan counties) is expected to increase slightly more than 5 percent each year from 1991 through 1995. Coal production from mines in southern and western Wyoming, however, are only expected to increase one or two percent each year from 1991 through 1995 (Figure 10). By 1995, coal production from Campbell County alone will be nearly 200 million tons; total State coal production will be nearly 235 million tons.

Table 5. COAL DELIVERIES BY MONTH FROM WYOMING MINES¹.

	1987		1988		1989		1990		1991	
	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE
JANUARY	12,085,570	12,085,570	10,976,860	10,976,860	14,283,020	14,283,020	15,059,530	15,059,530	14,960,450	14,960,450
FEBRUARY	10,315,680	22,401,250	11,431,380	22,408,240	11,488,140	25,771,160	13,328,290	28,387,820	15,480,110	30,440,560
MARCH	10,436,610	32,837,860	12,871,090	35,279,330	14,124,330	39,895,490	14,535,270	42,923,090	16,278,870	46,719,430
APRIL	10,429,180	43,267,040	12,694,660	47,973,990	13,489,450	53,384,940	14,155,470	57,078,560	14,820,240	61,539,670
MAY	10,619,470	53,886,510	12,017,500	59,991,490	13,149,170	66,534,110	13,882,590	70,961,150	14,589,790	76,129,460
JUNE	11,953,650	65,840,160	12,595,480	72,586,970	12,948,350	79,482,460	13,649,070	84,610,220	14,007,600	90,137,060
JULY	12,850,240	78,690,400	13,905,670	86,492,640	14,043,350	93,525,810	15,368,280	99,978,500		
AUGUST	13,460,470	92,150,870	15,041,090	101,533,730	15,428,210	108,954,020	16,046,910	116,025,410		
SEPTEMBER	12,651,550	104,802,420	13,433,610	114,967,340	13,795,760	122,749,780	15,166,020	131,191,430		
OCTOBER	12,248,080	117,050,500	13,696,190	128,663,530	14,523,480	137,273,260	15,244,760	146,436,190		
NOVEMBER	12,340,720	129,391,220	13,889,890	142,553,420	14,507,130	151,780,390	15,569,280	162,005,470		
DECEMBER	13,008,300	142,399,520	14,540,510	157,093,930	13,527,880	165,308,270	14,479,970	176,485,440		
TOTAL TONNAGE REPORTED		142,399,520		157,093,930		165,308,270		176,485,440		
TOTAL TONNAGE NOT REPORTED		4,089,128		6,494,270		5,831,734		7,521,261		
TOTAL TONNAGE PRODUCED ²		146,488,648		163,588,200		171,140,004		184,006,701		

¹ Source: COALDAT Marketing Reports by Resource Data International, Inc., compiled from FERC Form 423 filed monthly by electric utilities.

² Source: Wyoming State Mine Inspector's Annual Reports.

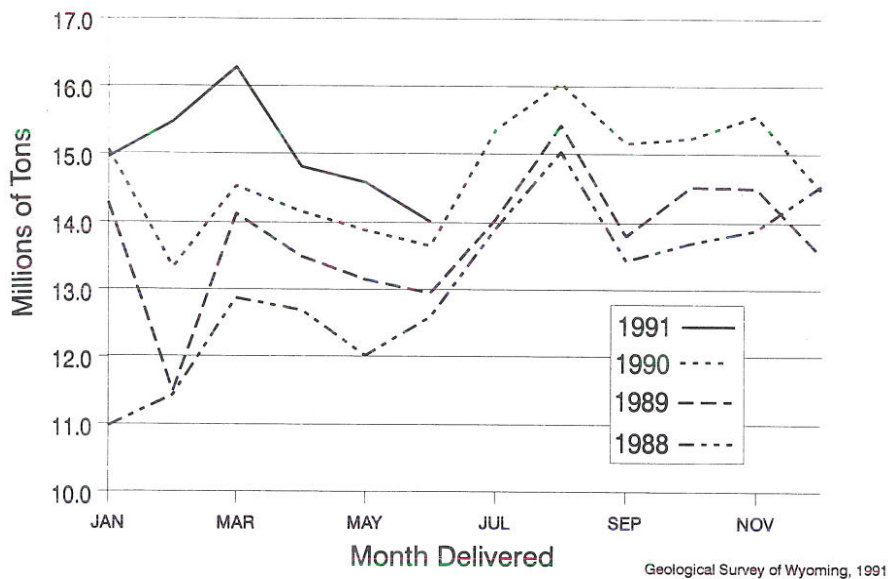


Figure 9. REPORTED DELIVERIES FROM WYOMING COAL MINES (FROM COALDAT MARKETING REPORT BY RESOURCE DATA INTERNATIONAL, INC., COMPILED FROM FERC FORM 423 FILED MONTHLY BY ELECTRIC UTILITIES).

Table 6 shows that sales of low-priced coal (F.O.B. mine prices less than \$5.00 per ton) have increased every year since at least 1985. Sales of low-priced coal are predicted to continue increasing at least through 1995. As more low-priced coal is sold by Wyoming producers, the average Statewide price paid for coal will also continue its decline. If the trend continues as expected, the average price of Wyoming coal will drop from the \$8.31 per ton in 1990 to \$7.08 per ton by 1995 (Table 1 on page 2).

During the first half of 1991, increased sales of coal on the spot market alone account for the predicted increase in the percentage of low-priced coal sales. Spot sales accounted for 16 percent of all coal deliveries to electric utility companies during the first half of 1991, as compared to a 12.5 percent share of total deliveries for a similar period in 1990. It is estimated that another 15 percent of the total sales is low-priced coal on short-term or renegotiated contracts.

Coal sales to different states may also be changing between 1990 and 1991. Significant increases (over 0.5 million tons each) in coal tonnages delivered to Arkansas, Missouri, Texas, Oklahoma, Oregon, Georgia, and Wisconsin more than offset significant decreases in coal tonnages delivered to Kansas, Indiana, and Washington between the first half of 1990 and the first half of 1991.

During the third quarter of 1991, the U.S. Bureau of Land Management (BLM) in Wyoming received nine coal lease applications under the new "lease by

Table 6. COAL PRODUCTION (1983 to 1990) WITH FORECAST TO 1995 (MILLIONS OF TONS).

	1983 ¹	1984 ¹	1985 ¹	1986 ¹	1987 ¹	1988 ¹	1989 ¹	1990 ¹	1991	1992	1993	1994	1995
Campbell County	88.2	106.8	113.9	111.0	122.3	135.7	143.8	154.7	162.5	170.8	179.4	188.8	198.5
Converse County	2.7	3.3	3.6	4.8	5.1	5.7	6.1	7.9	8.5	9.5	10.5	11.5	12.5
Sheridan County	2.9	2.5	2.4	1.4	1.2	0.9	0.1	0.1	0.1	M ²	M	M	M
Carbon County	4.8	5.1	3.3	1.5	2.2	4.1	4.3	4.5	4.5	4.5	4.1	3.8	3.5
Sweetwater County	9.5	8.9	13.2	12.9	11.8	12.2	12.0	11.9	12.7	13.0	13.5	14.0	14.5
Lincoln County	4.0	4.1	4.3	4.0	3.8	4.9	4.8	4.7	5.1	5.3	5.5	5.6	5.8
Hot Springs County	M	M	M	M	M	M	M	0.1	M	M	M	M	M
Total Wyoming ³	112.2	130.7	140.7	135.7	146.5	163.6	171.1	184.0	193.4	203.1	213.0	223.7	234.8
Annual change	4%	16.5%	7.7%	-3.6%	8.0%	11.7%	4.6%	7.5%	5%	5%	5%	5%	5%
Low-priced coal ⁴			6%	7%	8%	10%	17%	24%	31%	37%	42%	47%	51%

¹ These are actual values for comparison. ² M means minor tonnage (less than 0.1 million tons). Forecast by Geological Survey of Wyoming, September, 1991. ³ Totals may not equal sum of components because of independent rounding. ⁴ Estimated percentage of total production that is sold on the spot market, through short-term contracts [less than one year duration], or through renegotiated, longer-term contracts all at prices under \$5.00.

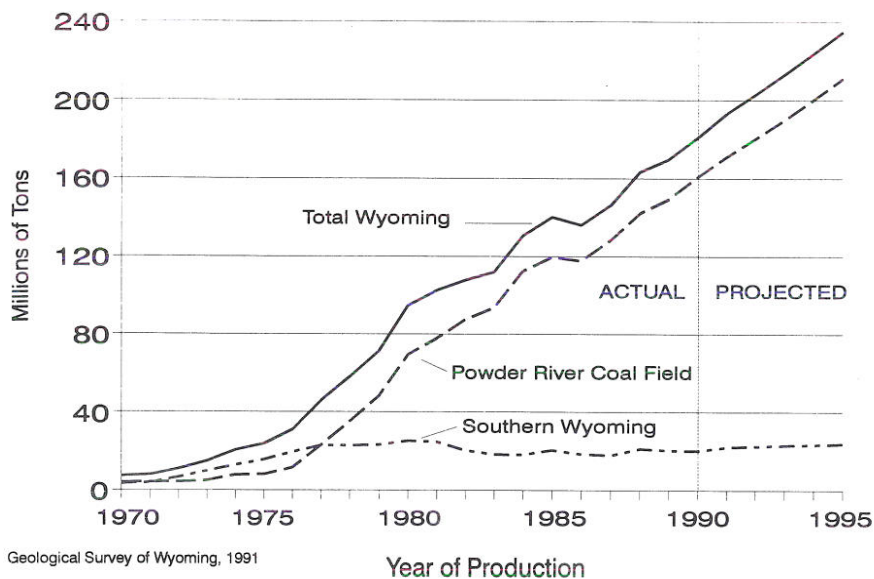


Figure 10. ANNUAL COAL PRODUCTION FROM WYOMING (1970 TO 1990) AND FORECAST TO 1995.

application” process. The renewed interest in leasing low-sulfur coal is in some measure a result of the passage of the Clean Air Act Amendments of last year, which have a real potential for increasing the demand for low-sulfur coal.

Six of the lease applications are in the Powder River Coal Field and include 1,035 million tons of coal reserves; the other three lease applications are in coal fields in western Wyoming and include 26 million tons of coal reserves (Table 7). Many of these lease applications are for maintenance tracts adjacent to existing leases. In some cases, the applicants have applied for maintenance tracts to sustain future mining operations because they have already sold all their existing reserves and want additional coal to secure contracts for future sales. In other cases, the applicants are basing their requests on mining efficiencies and (or) conservation of resources. In other words, it may be more efficient to recover some coal reserves via existing mining operations rather than through a new mine start-up. Similarly, if areas of marginal or unsalable coal (due to coal quality problems) exist off lease, but adjacent to existing mines, this coal could be made marketable if it were blended with higher quality coal already being mined.

On September 26, 1991, the BLM offered coal reserves in the Jacobs Ranch lease application in a competitive coal lease sale. Although the decision to offer Kerr-McGee’s Federal coal lease application for competitive sale was appealed, the sale occurred as planned. The only bidder for the coal tract was Kerr-McGee Coal Corporation. Their bonus bid for the 132,681,204 tons of coal in the tract was

Table 7. Federal coal lease applications pending in Wyoming, arranged in approximate order of priority for processing by the U.S. Bureau of Land Management (based in part on a personal communication from Alan Edwards, 1991)

Tract Name	Company Name (Controlling Company)	Coal Field	Estimated Recoverable Reserves (millions of tons)	Comments ¹
Jacobs Ranch	Kerr-McGee Coal Corp. (Kerr-McGee)	Powder River	132	LBA; lease sale held 9/26/91; sale appealed
Black Butte	Black Butte Coal Co. (Peter Keiwit Sons)	Green River	12	EBP; will be bypassed if not sold before 8/92
West Black Thunder	Thunder Basin Coal Co. (Arco Coal Co.)	Powder River	433	LBA
North Antelope	Powder River Coal Co. (Peabody Development)	Powder River	120	LBA
Rochelle	Powder River Coal Co. (Peabody Development)	Powder River	150	LBA
West Rocky Butte	Northwestern Resources (Montana Power Co.)	Powder River	50	LBA Requires Environmental Impact Statement
Millard Moses	Millard Moses	Bighorn	2	LBA
Deadman West	Bridger Coal Co. (NERCO, Inc.)	Green River	12	LBA
Eagle Butte	Amax Coal Co. (Amax, Inc.)	Powder River	150	LBA
TOTAL			1,061	

¹LBA = Lease by application; EBP = Emergency bypass lease

\$20,114,930 or about 15.24 cents per ton. Based on 1,708.62 acres in the tract, the bonus bid was about \$11,772.62 per acre. The lease is subject to an annual rental of \$3.00 per acre and a royalty rate of 12.5 percent of the value of the coal. Half the bonus bid and the royalties paid to the Federal government come back to the State of Wyoming. Because the lease sale was held under an appeal filed jointly by the Wyoming Outdoor Council, the Powder River Basin Resource Council, and the Wyoming Chapter of the Sierra Club, issuance of the lease is in doubt until the appeal is settled.

Developments in western and southwestern Wyoming

Several developments regarding the compliance problems at Utah Power and Light Company's (UPL's) Naughton power plant near Kemmerer were worth noting in the third quarter. First, the Wyoming Environmental Quality Council agreed to let the plant operate at a higher level of sulfur dioxide emissions while arbitration of UPL's coal supply contract with Pittsburgh and Midway Coal Mining Company (P&M) continues. UPL, an operating subsidiary of PacifiCorp, Inc., has until January 15, 1992, to submit a plan for bringing the plant into compliance with

the State's emission standards. Second, the Environmental Quality Council agreed to let the plant continue to operate after it was shown that UPL could reduce emissions by (1) burning only the lower sulfur coal in the two older, unscrubbed generating units, and (2) burning all the higher sulfur coal in the newer generating unit equipped with a scrubber.

Ark Land Company, a wholly-owned subsidiary of Arch Mineral Corporation, wants to develop an estimated 32 million tons of low-sulfur Federal coal located southeast of Rock Springs under the U.S. Bureau of Land Management's (BLM's) Preference Right Lease Application (PRLA) process. Ark Land Company applied for these PRLAs in 1970. BLM began their environmental analysis of the coal tracts (known as the Bean Springs PRLAs) in September, 1991. Ark Land Company must show by their exploration efforts and other studies that they have discovered "commercial quantities of coal" on the tracts. If Ark Land Company receives the Federal leases, a one-million-ton per year surface mining operation would be constructed on the 8,202 acres. The original mine plan, which called for construction of a rail spur between the mine and the Union Pacific main line to the north, has been revised for truck transportation of the coal instead.

Bridger Coal Company has applied for a coal lease adjacent to the existing Jim Bridger coal mine east of Rock Springs. The application for 2,121 acres of Federal coal will be processed under BLM's new "lease by application" process introduced after the Green River-Hams Fork Coal Region was decertified several years ago. The coal lease application would allow Bridger Coal Company to recover additional Federal coal from the Jim Bridger coal deposit. This coal deposit was developed to fuel the nearby Jim Bridger power plant in the early 1970s.

In another related activity, the fuels division of PacifiCorp, PacifiCorp Electric Generation, announced that it would be taking possession of Bridger Coal Company (an operating company of Nerco Coal Corporation) from NERCO, Inc., a subsidiary of PacifiCorp, in an attempt to decrease the indebtedness of NERCO. Evidently the indebtedness of NERCO is related to its non-coal ventures. NERCO also announced that NERCO Coal Corporation, a wholly-owned subsidiary of NERCO, Inc., would be moving from its St. Louis, Missouri, headquarters to the NERCO, Inc. headquarters in Portland, Oregon, where it would share management with NERCO Minerals Corporation. Under the new company structure, Bridger Coal Company would be more closely aligned with the fuel procurement branch of PacifiCorp.

Bridger Coal Company recently received national recognition for its reclamation work at the Jim Bridger mine. The company was presented with the Office of Surface Mining, Reclamation, and Enforcement's (OSM's) award for Excellence in Surface Mining and Reclamation. The award recognized the company's outstanding results in revegetation of native shrubs and grasses in an arid environment.

The Deadman underground coal mine northeast of Afton, in the northern part of the Hams Fork Coal Field (Figure 11), has been sealed and is undergoing final

reclamation. After a long history of development that began in the 1930s, the Wy-Ida Coal Company produced the last several thousand tons of coal from this mine in 1988. Although there was a potential local market for the high quality bituminous coal from this mine, Wy-Ida Coal Company declared bankruptcy in 1989 and forfeited a \$44,500 reclamation bond. The bond is funding the reclamation work for the mine and the surrounding area.

Developments in the Hanna Coal Field

Arch of Wyoming, a subsidiary of Arch Mineral Corporation, recently received approval from the Wyoming Department of Environmental Quality to operate a continuous miner/conveyor system at the Medicine Bow mine west of Hanna. The system is apparently similar to a technique recently used by Wyoming and West Virginia, Inc. to extract coal along highwalls exposed by surface mining (Wyoming Geo-notes No. 30, p. 32 and 34). The system allows extraction of coal not normally accessible by surface mining (e.g. beyond the economic limits of strippable coal). Arch believes it may be able to increase coal production at a specific mining site from 110,000 tons per year (via conventional surface mining techniques) to 750,000 tons per year.

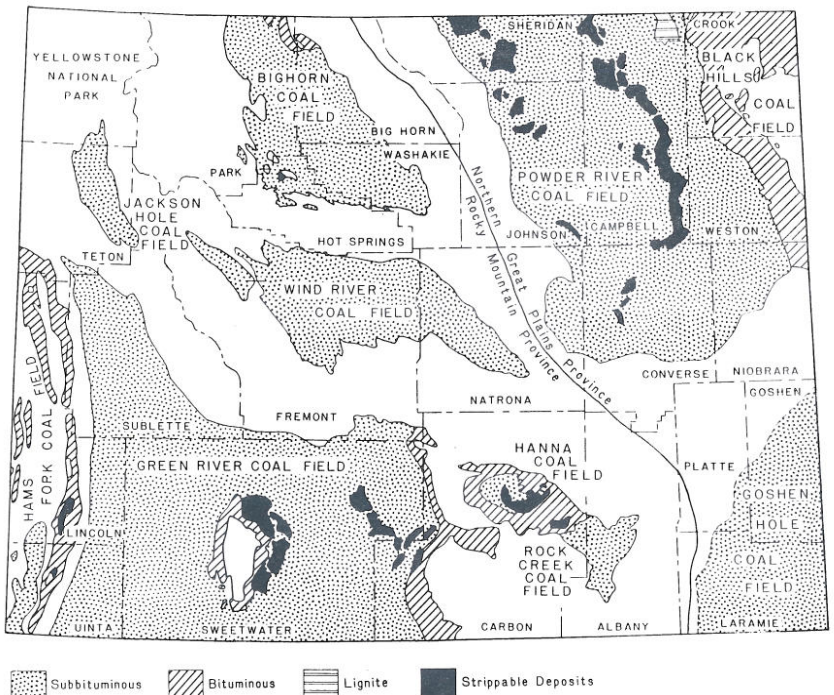


Figure 11. INDEX MAP OF WYOMING COAL FIELDS.

Cyprus-Shoshone Coal Company's Shoshone No. 1 underground mine has continued to supply coal for test burns at Fremont, Nebraska, Department of Utilities plant (no. 21, Figure 12). The coal is blended with lower Btu coal from Amax Coal Company's Belle Ayr mine south of Gillette. The coal from the Hanna Coal Field is being used as a peaking fuel to increase the heating content of the coal from Belle Ayr. The utility company is also planning to test some of the upgraded coal products from the Powder River Coal Field as it becomes available.

Cyprus-Shoshone Coal Company supplied 9,000 tons of spot coal from the Shoshone No. 1 mine to Nebraska Public Power District's Sheldon, Nebraska, power plant (no. 10, Figure 12). Contract coal from Thunder Basin Coal Company's Black Thunder mine is blended with 3-5 percent Shoshone No. 1 coal. The 9,000 tons will be used within a one-year period that started in September, 1991. Evidently, coal from Cyprus-Shoshone is being used because of its ash fusion characteristics and its higher heating value. These characteristics help clean out the power plant's cyclone boilers if the blended mixture is burned every few days.

Cyprus-Shoshone Coal Company also supplied 7,500 tons of test coal to St. Joseph Light and Power Company's Lake Road, Missouri, power plant (no. 8, Figure 12). The utility company apparently had intended to fuel their plant entirely with coal, but because the price of natural gas was 3-4 cents per million Btu less than that of coal (on a delivered basis), most of the fuel supplied to the plant has

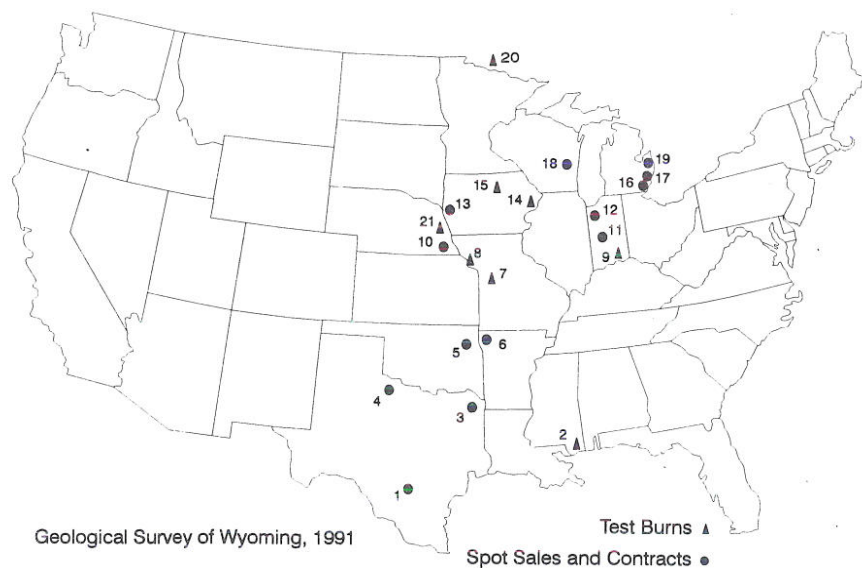


Figure 12. INDEX MAP OF COAL CONTRACT AND SALES ACTIVITIES INVOLVING WYOMING COAL MINES, NOTED DURING THE THIRD QUARTER OF 1991.

been natural gas. Coal from the Hanna Coal Field was burned without blending to compare its performance with contract coal from Kansas.

Developments in the Powder River Coal Field

A Montana-based coal company, Northwestern Resources Company (NWR), announced plans to construct a new coal mine that would be capable of producing 16 million tons of coal per year. The proposed Rocky Butte coal mine would be located about 12 miles southeast of Gillette and north of Carter Mining Company's Caballo mine. It would be the fifteenth coal mine in Campbell County. NWR, an operating unit of Western Energy Company, which in turn is a wholly-owned subsidiary of Entech, Inc., a non-utility holding company of Montana Power Company, has acquired 100 percent of the interests held by Texas Energy Services, Inc. and Northwestern Mutual Life Insurance Company. These interests include a Federal coal lease acquired in the 1982 Powder River Basin competitive coal lease sale and a State of Wyoming coal lease. The diligent development terms of the Federal coal lease require that coal production begin by February 1, 1993. NRC is also seeking an additional Federal tract adjacent to the current lease under the "lease by application" process. If NRC is successful in obtaining the additional Federal coal, it is possible that both lease tracts could be combined into one Federal coal lease with a new diligent development schedule.

NWR is currently involved in preparing Federal and State mining permit applications for the project as well as seeking potential buyers for the coal. Although Western Energy Company operates the Rosebud mine in Montana (which supplies coal to Montana Power Company's Colstrip and Corette power plants in Montana) and the Grass Creek mine in Hot Springs County, Wyoming (which supplies coal to bentonite plants in the Bighorn Basin), there were no announced plans for the new Rocky Butte mine to replace any of the coal from these mines.

The Rocky Butte area, which includes both the existing Federal lease and the proposed Rocky Butte West "lease by application" tract, contains about 600 million tons of recoverable coal reserves. Coal quality varies within the tract, but averages 8,250 Btu/pound, 0.38 percent sulfur, 5.3 percent ash, and 30.85 percent moisture, all on an as-received basis. Although the heat value of coal in the Rocky Butte area is generally lower than that in other mines in the eastern part of the Powder River Coal Field, NWR may be able to upgrade it. A patented process, currently being tested at a demonstration plant near Colstrip, Montana, is capable of converting raw coal with 25 percent moisture, 0.7 percent sulfur, and a heating value of 8,600 Btu/pound to "Syncoal", which contains less than 3 percent moisture, less than 0.6 percent sulfur, and a heating value of over 11,700 Btu/pound.

Black Hills Power and Light Company announced plans to build a new 80-megawatt coal-fired steam electric generating plant near Gillette. The new \$100 million plant, known as Neil Simpson No. 2, would be located adjacent to the existing 300-megawatt Wyodak and the 20-megawatt Neil Simpson No. 1 power

plants and the Wyodak coal mine. Construction is planned to begin in late 1993 or 1994 and the plant is expected to be on line in 1997. The plant would use about 400,000 tons of coal a year from Wyodak Resource and Development Corporation's Wyodak mine. Like the Neil Simpson No. 1 and the Wyodak plants, the new power plant would be air-cooled. It would also use treated sewage water from the City of Gillette. The plant will be equipped with electrostatic precipitators to remove particulate matter and dry scrubbers to control sulfur dioxide emissions. And it will meet the new emission standards set by the Clean Air Act Amendments of 1990. The project is currently in the design and permitting phase.

Cordero Mining Company, a subsidiary of Sun Coal Company and the operator of the Cordero coal mine south of Gillette, was awarded a \$17.1 million Federal grant from the U.S. Department of Energy's (DOE's) Clean Coal Technology Program. The funds will assist Cordero and Carbontec Wyoming, Inc. of Bismarck, North Dakota, in construction of a \$34.3 million coal upgrading demonstration project near the Cordero mine. Earlier, Cordero had received a \$1 million loan from the Wyoming Investment Fund Committee to assist in preliminary testing of Cordero coal (*Wyoming Geo-notes No. 30*, p. 35). The demonstration plant will initially produce about 250,000 tons of dried coal product a year. While preliminary design and engineering work on the plant should begin in 1992, actual construction will not begin until 1993.

Carbon Fuels Corporation and their Char-Fuels project failed to obtain the \$12.3 million they had sought from round four of DOE's Clean Coal Technology Program. Similarly, Heartland Fuels Corporation, a sister corporation of Wisconsin Power and Light Company, failed to obtain \$44 million to assist it in construction of an \$88 million K-Fuel plant near Gillette.

Mobil Corporation announced that it wants to sell its subsidiary Mobil Coal Producing, Inc. A New York financial company was retained by Mobil to solicit and accept offers for the coal company and its holdings, which consist of the Caballo Rojo mine and its reserves, additional coal reserves in Illinois, and a marketing office in Denver. The Caballo Rojo mine, which is located south of Gillette, employs about 150 people and produced 8.6 million tons of coal in 1990. The mine property reportedly contains approximately 500 million tons of low-sulfur coal reserves (with as received heating values of 8,400 to 8,500 Btu/pound); total reserves controlled by the company are reportedly 2,036 million tons.

During the third quarter of 1991, several Wyoming coal mines in the Powder River Coal Field received national recognition for their achievements in mine safety and in reclamation of mined lands. Cordero Mining Company's Cordero mine received the first place Sentinel of Safety award (which is the Nation's most prestigious mine safety award) for 1990 after logging some 393,610 hours without a lost-time injury. Mobil Coal Producing, Inc.'s Caballo Rojo mine won the second place award, behind Cordero. Carter Mining Company was honored with an Excellence in Surface Mining and Reclamation award for developing an innovative overburden management program at the Rawhide and Caballo coal mines near Gillette. By the placement of specific types of overburden, Carter prevented possible environmental damage while ensuring optimum hydrologic conditions

and providing the highest quality materials for new plant growth on reclaimed lands.

Glenrock Coal Company, an operating company of Nerco Coal Corporation, is apparently being moved from NERCO, Inc. to the fuel procurement and marketing branch of PacifiCorp in a manner similar to that discussed above for Bridger Coal Company. Glenrock Coal Company's Dave Johnston mine will continue to produce coal for the nearby Dave Johnston power plant. It appears that PacifiCorp may be deemphasizing its captive mines (e.g. Dave Johnston, Jim Bridger, and the Centralia mine in Washington) by purchasing low-priced spot coal from other suppliers. PacifiCorp recently sent out solicitations for an appreciable amount of spot coal for use in 1992 at the three power plants served by these captive mines. At the same time, PacifiCorp is keeping both the Antelope mine in northern Converse County and the Spring Creek, Montana, mine in their NERCO Coal Corporation division. Both these mines have been quite successful in selling their coal on the open market.

Coal contracts - Powder River Coal Field

Coal purchasing activities during the third quarter of 1991 were numerous, but somewhat less than those in the second quarter, as both spot sales and short term contracts were announced. Coal sales for test burns decreased from those reported in the second quarter of this year.

New coal contracts and sales are summarized below:

A) The Grand River Dam Authority (GRDA's) and Carter Mining Company's Rawhide mine renegotiated the price on a long-term, 1.8 million tons per year contract for supplying the Grand River Dam plant near Choteau, Oklahoma (no. 5, Figure 12). The companies also agreed on an option for additional spot coal, under a previously-signed long-term contract, but at a recently renegotiated price. The renegotiated price on delivered coal was reportedly 13 percent lower than the original contract price. GRDA had earlier rejected three bids on compliance coal from Oklahoma coal producers because delivered prices were from 25-30¢ per million Btu higher than those from Wyoming producers.

B) Cordero Mining Company will supply 0.5 - 0.6 million tons of spot coal from the Cordero mine to Iowa Public Service Company's Neal No. 4 unit (no. 13, Figure 12). The coal will fill this power plant's total spot coal needs for 1992. Chicago and North Western Transportation Company (C&NW) will transport the coal on both Western Railroad Properties, Inc. (WRPI) and Union Pacific Railroad (UP) trackage.

C) Mobil Coal Producing, Inc., supplied 0.33 million tons of spot coal from the Caballo Rojo mine to West Texas Utilities' Oklaunion generating plant (no. 4, Figure 12). The utility company had an option to take an additional 0.17 million tons of coal under this contract but the final amount of coal delivered to the plant was not announced.

D) In 1992, NERCO Coal Company's Antelope mine and Rochelle Coal Company (a subsidiary of Peabody Coal Company) will each supply 0.5 million tons of spot coal to three Michigan power plants operated by Detroit Edison. The coal will be delivered to the Monroe, River Rouge, and St. Clair plants (nos. 16, 17, and 19, respectively, Figure 12). Both coal companies could also supply a total of 0.7 million tons of additional spot coal to these and possibly other Detroit Edison plants, if needed.

E) Amax Coal Company's Belle Ayr mine supplied 0.15 - 0.20 million tons of spot coal to Wisconsin Power and Light Company's Columbia, Wisconsin, power plant (no. 18, Figure 12) during the third quarter. The coal originated on WRPI trackage with C&NW unit trains and terminated on the Soo Line.

F) Amax Coal Company began shipments in August on a 0.5 million ton spot coal contract with San Antonio Public Service Company's J.T. Deely, Texas, electric generating plant (no. 1, Figure 12). C&NW will transport the coal from the Belle Ayr mine to the power plant. The contract will continue into 1992. The published F.O.B. mine price for the coal was \$3.50 per ton for 8,500 Btu/pound coal. Published bid prices for this contract solicitation ranged from \$3.50 per ton for 8,400 Btu/pound coal to \$5.05 per ton for 8,800 Btu/pound coal. The average bid price for the six bids considered in this solicitation was slightly over \$4.00 per ton.

G) Carter Mining Company's Rawhide and Caballo mines, Amax Coal Company's Belle Ayr and Eagle Butte mines, and Triton Coal Company's Buckskin mine will supply a total of 0.96 million tons of coal to Indiana-Michigan Electric Power Company's Rockport, Indiana, power plant (no. 11, Figure 12) from October 1 of this year through January 1, 1992. Exact amounts of coal purchased from each mine were not announced. The utility company also has options to buy an additional 1.26 million tons from these coal suppliers during 1992. An estimated F.O.B. mine price for the coal is \$3.75 per ton for 8,500 Btu/pound coal.

H) Mobil Coal Producing, Inc.'s Caballo Rojo mine supplied 0.16 million tons of spot coal to Northern Indiana Public Service Company's Dean H. Mitchell, Indiana, power plant (no. 12, Figure 12) during the third quarter.

I) A yet to be announced coal producer in the Powder River Coal Field will supply Southwestern Electric Power Company's Welsh, Texas, power plant (no. 3, Figure 12) and the Flint Creek, Arkansas, power plant (no. 5, Figure 12) with a total of 3.3 million tons of coal during the last quarter of this year and the first quarter of 1992. The published F.O.B. mine price for the 8,325 Btu/pound coal was \$3.41 per ton. Transportation of the coal to both plants will be via Burlington Northern Railroad (BN).

Coal purchased for test burns is summarized below:

J) An unannounced coal producer from the Powder River Coal Field supplied 40,000 tons of spot coal to Mississippi Power Company's Daniel, Mississippi, power plant (no. 2, Figure 12) during the second quarter of this year.

This test coal sale was omitted from last quarter's summary. The power company is also planning another test burn of 100,000 tons of coal in early 1992. The coal is transported by rail to Paducah, Kentucky, where it is blended with an eastern bituminous coal and then shipped by barge on the Tombigbee River to the Daniel plant.

K) Rochelle Coal Company's Rochelle mine will furnish several unit trains of coal for test burns at Missouri Public Service Company's Sibley, Missouri, power generating plant (no. 7, Figure 12). The coal will be tested during the fourth quarter of 1991 in a blend with coal from the Illinois Basin.

L) The Rochelle mine also furnished 64,000 tons of test coal to Indiana-Kentucky Electric Power Company's Clifty Creek, Indiana, power plant (no. 9, Figure 12) during the third quarter. The coal was blended with eastern bituminous coal from Virginia.

M) NERCO Coal Corporation's Antelope mine supplied 22,000 tons of coal to Iowa Electric Light and Power Company's Sutherland, Iowa, power plant (no. 15, Figure 12). The utility company also has a long-term contract with Mobil Coal Producing Inc.'s Caballo Rojo mine and has been testing this coal with varying amounts of high-sulfur, high Btu petroleum coke.

N) Carter Mining Company's Rawhide mine and NERCO Coal Corporation's Antelope mine have each supplied 11,000 tons of test coal to Ontario Hydro's Atikokan power plant in Ontario Province, Canada (no. 20, Figure 12). The plant currently burns lignite mined in Saskatchewan Province. Coal from NERCO Coal Corporation's Spring Creek, Montana mine will also be tested at Atikokan.

O) Mobil's Caballo Rojo mine supplied 10,000 tons of test coal to Muscatine (Iowa) Power and Light Company's Unit No. 9 (no. 14, Figure 12) during the third quarter.

Industrial Minerals and Uranium Update

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

Aggregate (construction)

The proposed limestone aggregate quarry west of Casper near Bessemer Bend is nearing operation. Rissler & McMurry began construction of an access road to the site in late September, and the company plans to begin production as soon as possible. The aggregate at this site is the Triassic Alcova Limestone.

Meridian Aggregates, the operator of the granite ballast quarry west of Cheyenne, is also selling construction aggregate. According to company repre-

sentatives, some has been sold to the cities of Cheyenne and Laramie for street paving projects and some for use in the construction of the new Denver airport. In past years, this quarry produced only railroad ballast, which is still purchased by both the Union Pacific and Burlington Northern Railroads. The rock quarried at this site, although known as "Sherman Ballast", is not the Sherman Granite, but a Precambrian granitic gneiss.

The production of railroad ballast is continuing at the Bald Butte quarry south of Lusk. The quarry is operated by Lamb Construction of Torrington, Wyoming, and the ballast is used by the Chicago and North Western railroad. The rock at this site is a granitic gneiss of Precambrian age.

The owners of the land leased for ballast production in the Cooney Hills southwest of Wheatland continue to develop markets. Precambrian granite from this area has been tested and found suitable for use as railroad ballast.

Aggregate (decorative)

Georgia Marble operates a white marble aggregate quarry west of Wheatland, and processes the marble at a plant site on the north edge of the town. The marble is Precambrian age, probably Archean (Paul Graff, personal communication, 1991). A variety of products are produced at this plant including roofing granules, landscape rock, coloring agents (including paint pigment), and aggregate for white, precast, concrete products. New to Georgia Marble's operation is a coloring shop where several colors of aggregate are produced by dyeing the white marble.

Decorative aggregate, including red clinker, green serpentine, and other rocks, are produced and sold by Wyoming Red Rock of Gillette. Most of this aggregate is processed for landscape rock.

Bentonite

Wyoming is the leading producer of bentonite, a clay mineral used in a variety of products. Since 1982, the bentonite industry has been producing at less than half of its rated capacity due to a decline in oil and gas well drilling. Bentonite's primary use is in drilling mud. Production, however, has been increasing again due to an increase in the use of bentonite in environmental cleanup and waste-isolation projects. Wyoming's bentonite production should increase over last year's production of about 2.5 million tons. The bentonite currently produced in Wyoming comes from the Upper Cretaceous Mowry and Frontier formations.

Cement

Cement is produced in Wyoming at the Mountain Cement Company's plant south of Laramie. Limestone from the Permian-Pennsylvanian Casper Formation, gypsum from the Triassic Chugwater Formation, and silicic shale from the Cretaceous Mowry Formation are the major ingredients in the portland cement produced at this plant.

Iron is also used as an additive for certain types of cement. Tailings from the abandoned titaniferous magnetite mine at Iron Mountain had been used. Because this source of iron contained too much titanium, the plant is now using mill fines from the abandoned steel plant at Pueblo, Colorado. Most of this material originally came from Precambrian iron formation mined at the Sunrise mine near Hartville, Wyoming, in Platte County.

Decorative and Dimension Stone

Sunrise Stone continues to quarry and sell 5' by 5' by 10' blocks of black granite (amphibolite) at the Kennedy Ranch quarry in northern Albany County (*Wyoming Geo-notes No. 31*, p. 28). The blocks are shipped by truck to a finishing plant in Arkansas. The stone, which is marketed as "Wyoming Raven", is receiving a great deal of interest among the stone industry. It is probably the blackest stone produced in the United States at the present time and is perhaps equivalent to Nero Assoluto (Absolute Black) from South Africa, which is currently the world standard for black decorative stone. There is now a permanent crew at the site, and production is nearing four blocks per day. The amphibolite is Precambrian in age.

Sunrise Stone is also interested in producing other decorative rocks in Wyoming. The company has located claims on purple-black, blue-black, and green-black granites (Precambrian age gabbros of the Lake Owen mafic complex) in the Muddy Mountain area of the Medicine Bow National Forest north of Foxpark, in southern Albany County. The company is preparing plans for initial work next year.

Rustic West Stone Company of Powell, Wyoming, is quarrying and selling thin, rough-quarried slabs of brown marble (limestone) from a quarry near Tensleep in Washakie County. This stone, which is from an unnamed Triassic limestone unit, is suitable for interior or exterior walls, flooring, and other decorative uses. It is marketed throughout the United States, but particularly in the New York City area, according to Dick Cosgrove of Rustic West Stone.

The Geological Survey of Wyoming completed and published a descriptive pamphlet on decorative stone in Wyoming. This publication, funded by the Wyoming Department of Commerce's, Division of Economic and Community Development, contains pictures and descriptions of 64 potential decorative stones and 16 examples of decorative aggregate in Wyoming. Public Information Circular 31 is available from the Geological Survey of Wyoming (p. 47)

Stone quarrying is an art compared to other types of mineral and rock extraction. Since stone quarrying requires large pieces of stone free from cracks, there is no extensive blasting. Blocks are cut by a variety of procedures including continuous drilling, sawing, or hammers and wedges. Consequently, these operations can operate near residences without creating a disturbance. There is even a stone quarry in the Adirondack State Park, New York. The largest stone quarries, including loading areas, generally cover less than 20 acres.

Fertilizer

Chevron Chemical Corporation's fertilizer plant southeast of Rock Springs combines phosphate mined in Utah, with sulfur from refined natural gas from western Wyoming. Earlier this year, Chevron announced that its plant was for sale. Just after the third quarter, Chevron announced that J.R. Simplot Co. and Farmland Industries were the potential buyers.

Limestone and Lime

Dakota Coal Company, a division of Missouri Basin Electric which operates the Laramie River power plant northeast of Wheatland, has decided to construct a lime plant north of Lovell, Wyoming. This plant will use limestone from a quarry north of the state line in Montana. There are plans to open a limestone quarry east of the plant site in Wyoming at a later date. Lime produced at the plant will be used for emissions control at coal-fired power plants in North Dakota and Wyoming.

Mineral Pigment

During past years, Red dog Minerals has shipped small amounts of iron oxide pigment from the former Sunrise iron mine near Hartville. Because CF&I Steel, the former owners of Sunrise, have forfeited their bond and abandoned the Sunrise property, shipments of pigment have stopped and there are no plans to resume production, at least until the ownership of Sunrise is determined. The present bond holder is Farmer's Union Insurance of San Diego, California. They asked the Wyoming Department of Environmental Quality if complete removal of all structures and mine workings is necessary for reclamation.

Trona and Soda Ash

Five companies refine soda ash from mined trona west of Green River in Sweetwater County. Several new-product facilities are under construction at these sites. In October, 1991, Tenneco announced that it was planning to sell previously unmarketed calcined trona to S & S Industries, of Maysville, Kentucky (Wyoming Geo-notes No. 31, p. 30). S & S plans to use the calcined trona to produce caustic soda and other sodium-based chemicals.

Tenneco is continuing to expand its facilities. This expansion will add about 100 new jobs and increase Tenneco's trona production to 4.4 million tons per year, compared to its present two million tons.

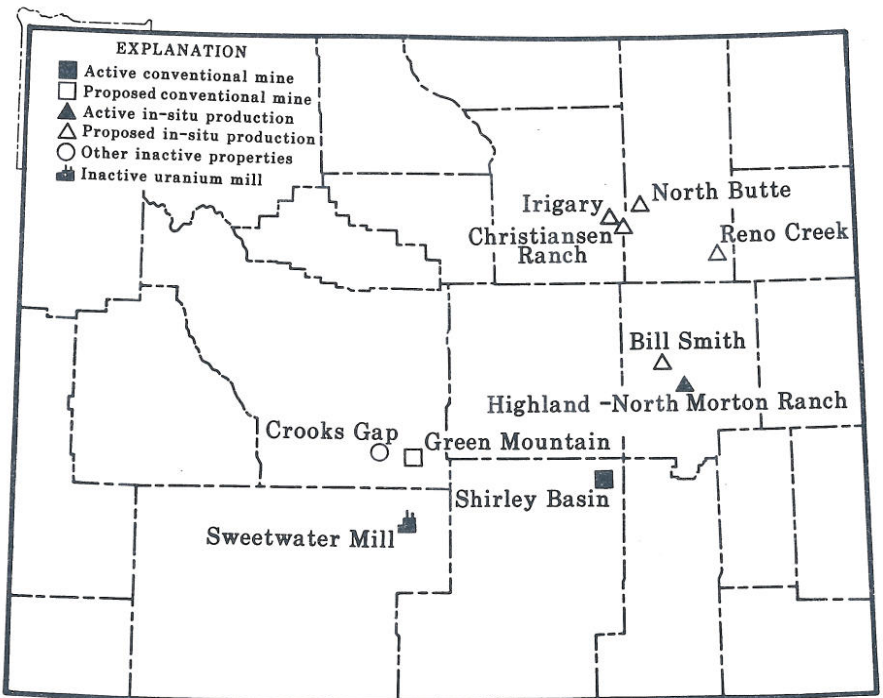
BWAB, Inc., of Denver, Colorado, is conducting exploratory drilling and testing the feasibility of extracting trona from black trona water in an area south of Eden, Wyoming. Black trona water is organic-rich ground water containing potentially recoverable trona.

Uranium

The spot market price of uranium dropped again in the third quarter of 1991 to \$8.75 per pound of yellowcake.

As Pathfinder Mines Corporation resumed uranium mining and milling at the Shirley Basin mine (Wyoming *Geo-notes No. 31*, p. 30), some of the crew that were hired to remove overburden and expose the ore body at the open-pit mine were laid off. There are no plans for further layoffs, according to company officials. The Shirley Basin mine is the only active conventional (open-pit or underground) uranium mine in Wyoming (Figure 13). Pathfinder Mines is wholly owned by COGEMA, Inc., which is wholly owned by COGEMA-France, a French company.

Pathfinder announced that it bought the Reno Creek property in the Powder River Basin. The company also plans to begin solution mining operations at the North Butte in-situ property in the Powder River Basin in 1993. Pathfinder will join possibly three other in-situ producers. Power Resources, a British-based company, is producing uranium at the Highland and North Morton Ranch properties in Converse County north of Douglas. Total Minerals, a division of Electricite de



GEOLOGICAL SURVEY OF WYOMING, 1991

Figure 13. ACTIVE AND PROPOSED URANIUM MINES AND MILLS IN WYOMING.

France, is planning to produce uranium from the Irigary and Christiansen Ranch properties in the Powder River Basin in 1992. Rio Algom, a Canadian company, is testing solution mining at the Bill Smith property in the southern Powder River Basin (Figure 13).

U. S. Energy-Crested Corporation (USE-CC) announced its imminent purchase of the Sweetwater uranium mill in the Red Desert area of eastern Sweetwater County from Union Minerals. The mill, which was Wyoming's largest in 1982, closed in 1983. USE-CC plans to use the mill for processing uranium from the Kennecott and USE-CC's proposed underground uranium mine at Green Mountain, south of Jeffrey City in Fremont County, and possibly uranium from USE-CC's uranium properties at Crooks Gap (Figure 13).

Funding for a Federal bill granting compensation to miners who worked in underground uranium mines before 1972 has been delayed. Congress has authorized compensation for health effects caused by exposure to radon, but funding details and qualifications have not yet been determined.

METALS AND PRECIOUS STONES UPDATE

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

Undisclosed companies and consultants explored for copper, gold, and zinc at several locations in the State this summer including the Hartville uplift, Medicine Bow Mountains, Seminoe Mountains, Sierra Madre, Green River Basin, Granite Mountains, Wind River Range, and the Absaroka Mountains (Figure 14). No discoveries were reported by the end of the summer.

The Metals and Precious Stones Division of the Geological Survey of Wyoming completed mapping projects in the Seminoe Mountains greenstone belt and in the Cooper Hill mining district in the northeastern Medicine Bow Mountains. At the end of the summer, the Division began collecting data for next year's projects to include (1) a mapping project in the Rattlesnake Hills of the Granite Mountains, (2) a study of the mines and mineral deposits of the Encampment district of the Sierra Madre, and (3) a study of the potential for nickel and chromium resources associated with metakomatiites in the State's Archean greenstone terranes.

Cooper Hill, Medicine Bow Mountains

The Geological Survey of Wyoming completed a 1:12,000-scale geologic map of the historic Cooper Hill mining district this summer. The district lies in a faulted synformal succession of Proterozoic sedimentary and igneous metamorphic rocks including metalimestone, quartzite, thin quartz pebble

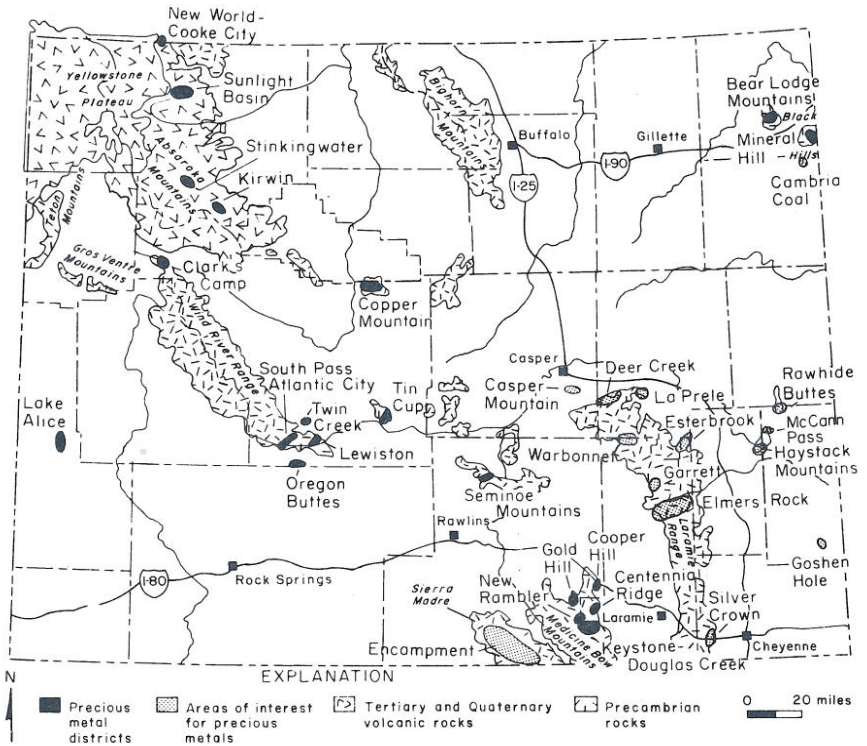


Figure 14. PRINCIPAL METAL DISTRICTS AND MINERALIZED REGIONS OF WYOMING.

metaconglomerate, mica schist, metagabbro, amphibolite, and metabasalt. Based on lithologies, the succession appears to be overturned, but unfortunately, no features used to determine the tops of beds were preserved.

Schoen (1953) reported that mineralization included argentiferous galena, some gold, and minor copper. Many of the mines and prospects are on epidote-chlorite-actinolite-hydrogrossular-magnetite-calcite-sulfide skarns, galena-pyrite replacement deposits, and quartz veins.

Seminole Mountains

By the end of the summer, the Geological Survey of Wyoming also completed mapping of the Seminole Mountains Archean greenstone belt in central Wyoming. The belt is formed of 8,000 feet of a lower, isoclinally folded, succession of mafic crystalline rocks that include amphibolite, mica schist, and minor serpentinite.

This unit is overlain by about 1,000 feet of mafic metavolcanics with aphyric serpentinites, cumulate serpentinites, and spinifex textured basaltic and peridotitic metakomatiites (Klein, 1981). The uppermost succession consists of 2,000 feet of banded iron formation, metapelite, mica schist, and amphibolite (Hausel, 1991).

Mineralization includes gold in quartz-carbonate-sulfide veins in a broad zone of propylitized amphibolites, copper-gold-silver in shears, some weak zinc-lead anomalies in shears, and low-grade iron in oxide-facies banded iron formation.

Sierra Madre (Encampment district)

The Geological Survey of Wyoming (GSW) began examining and mapping mines and prospects in the Sierra Madre of southeastern Wyoming. Samples have been collected from many mines, but the most interesting mine was the Kurtz-Chatterton mine on Copper Creek south of Encampment. A zone of copper mineralization associated with veins and stockworks was traced over a distance of at least 2,500 feet (and may be continuous over 4,000 feet) with a maximum width of 600-800 feet. The deposit occurs in the Sierra Madre granite (quartz monzonite ?) and has minor stockworks with secondary (?) biotite. Petrographic studies are planned.

Samples collected by the GSW contain abundant primary and secondary copper minerals including pyrite. Historic reports suggest some gold and silver also occurred in the sulfides (Hausel, 1989, p. 156). Although numerous samples were collected by the GSW, no assays are yet available.

Joint Mineral Resources Field Conference

In September, The Wyoming Geological Association (WGA), The Geological Survey of Wyoming (GSW), and the University of Wyoming's Department of Geology and Geophysics (UW) jointly hosted the WGA's annual field conference, which was held in Laramie. Gary Winters was General Chairman of the very successful field conference, which was attended by representatives from 13 states and Canada. The two days before and after the day of formal talks on Wyoming's mineral resources were devoted to field trips. Many of the attendees at the five-day meeting showed strong interest in Wyoming's base metal and precious metal and stone potential.

The Field Trip Chairman for the conference was W.D. Hausel of the Metals and Precious Stones Division of the GSW. On the first two days of the conference, field trips went to the somewhat snowy Seminoe Mountains greenstone belt and to the South Pass greenstone belt.

The Seminoe Mountains trip was led by W.D. Hausel. Trip attendees looked at the gold-sulfide vein deposits at the Penn mines on Bradley Peak and at some intensely deformed banded iron formation, before looking at a well preserved 1,000-foot section of metamorphosed komatiites. The metakomatiite section

includes several ultramafic flows with spinifex tops and cumulate bottoms (Blackstone and Hausel, 1991). From the Seminoe Mountains, the field trip continued on to the South Pass greenstone belt.

On the following day at South Pass, W.D. Hausel (GSW), J.D. Love (U.S. Geological Survey), and R. Redfern (Goldstake Exploration) showed the participants examples of the Archean and Phanerozoic section of the South Pass greenstone belt to include a cumulate metaperidotite (komatiite), banded iron formation, pillow metabasalt, metagreywacke with graded and cross bedding, and gold-bearing shears at the Duncan and Carissa mines (Hausel and Love, 1991). Redfern provided the attendees with a description of a new paleoplacer gold deposit south of Atlantic City, which was discovered by Fred Groth of Sawatch Gold Placers, Inc. Goldstake and Sawatch have been exploring the deposit over the past three years, and early indications are favorable. Love provided the group with some insights on the huge Twin Creek and Oregon Buttes gold paleoplacers along the flanks of the greenstone belt. Stops at the Oregon Buttes paleoplacer and at the Dickie Springs, Greene, and Oregon Gulch placers were highlighted when Love showed the crowd a vial of gold panned from the Greene placer.

On the day after the formal conference talks were presented in Laramie, field trips went to the Laramie Range anorthosite complex (led by B.R. Frost, UW, and J.P. Simons, consultant), to industrial mineral deposits of southeastern Wyoming (led by R.E. Harris, GSW), and to coal deposits of the Hanna Basin (led by J.M. McClurg, UW). The trip to the anorthosite complex included a visit to the massive titaniferous magnetite deposits hosted by the complex, including the Strong Creek disseminated deposit, which is one of the largest titaniferous magnetite deposits in North America (Frost and Simons, 1991). The trip on the following day, began with a tour of the Sloan diamondiferous kimberlites, and a visit to Dia Met Minerals' diamond processing plant. This portion of the trip was led by M.E. McCallum of Colorado State University and M.A. Waldman of Walding Consulting (McCallum, 1991; and Waldman, 1991). R.S. Houston (UW) then showed the participants some Proterozoic radioactive metaconglomerates in the Medicine Bow Mountains (Houston and Graff, 1991).

The conference papers and field trip guides were published in the Wyoming Geological Association's 42nd Field Conference Guidebook, entitled, *Mineral resources of Wyoming*. The guidebook is available for purchase by mail from the Wyoming Geological Association, P. O. Box 545, Casper, Wyoming 82602 (307/237-0027) or it can be purchased over-the-counter at the Geological Survey of Wyoming offices in Laramie.

References cited

- Blackstone, D.L., Jr., and Hausel, W.D., 1991, Field guide to the Seminoe Mountains, in Frost, B.R., and Roberts, S., editors, 1991, Mineral resources of Wyoming, Wyoming Geological Association 42nd Field Conference Guidebook, p. 201-210.

- Frost, B.R., and Simons, J.P., 1991, A field trip to the Laramie anorthosite complex and its associated mineral resources *in* Frost, B.R., and Roberts, S., editors, 1991, Mineral resources of Wyoming, Wyoming Geological Association 42nd Field Conference Guidebook, p. 211-216.
- Hausel, W.D., 1989, The geology of Wyoming's precious metal lode and placer deposits: Geological Survey of Wyoming Bulletin 68, 248 p.
- Hausel, W.D., 1991, Precambrian geology of the Seminoe Mountains (iron-gold) mining district, Bradley Peak Quadrangle, Carbon County, Wyoming: Geological Survey of Wyoming Open File Report 91-3, scale 1:24,000.
- Hausel, W.D., and Love, J.D., 1991, Field guide to the geology and mineralization of the South Pass region, Wind River Range, Wyoming, *in* Frost, B.R., and Roberts, S., editors, 1991, Mineral resources of Wyoming, Wyoming Geological Association 42nd Field Conference Guidebook, p. 181-200.
- Houston, R.S., and Graff, P.J., 1991, Northern Medicine Bow Mountains geologic summary, *in* Frost, B.R., and Roberts, S., editors, 1991, Mineral resources of Wyoming, Wyoming Geological Association 42nd Field Conference Guidebook, p. 259-262.
- Klein, T.L., 1981, The geology and geochemistry of the sulfide deposits of the Seminoe district, Carbon County, Wyoming: Ph.D. dissertation, Colorado School of Mines, Golden, 232 p.
- McCallum, M.E., 1991, The Sloan 1 and 2 kimberlite complex near the southern boundary of the State Line district of the Colorado-Wyoming kimberlite province *in* Frost, B.R., and Roberts, S., editors, 1991, Mineral resources of Wyoming, Wyoming Geological Association 42nd Field Conference Guidebook, p. 229-250.
- Schoen, R., 1953, Geology of the Cooper Hill district, Carbon County, Wyoming: M.A. thesis, University of Wyoming, Laramie, 41 p.
- Waldman, M.A., 1991, Guide to Dia Met Minerals' diamond recovery plant near Sloan Ranch, Colorado, *in* Frost, B.R., and Roberts, S., editors, 1991, Mineral resources of Wyoming, Wyoming Geological Association 42nd Field Conference Guidebook, p. 251-257.

Table 8. MINERAL RESOURCE AND RESERVE BASE ESTIMATES FOR WYOMING.

PETROLEUM	
Remaining Resources (January 1, 1991)	
Discovered (Includes 10 billion barrels recoverable by enhanced recovery techniques)	12.7 billion barrels ¹
Undiscovered	7.6 billion barrels ¹
Total	20.3 billion barrels
Remaining Reserve Base (January 1, 1991)	
Measured reserves (Proved reserves) (Includes 0.83 billion barrels of oil, 0.67 billion barrels of gas liquids, and 0.10 billion barrels of condensate)	1.50 billion barrels ²
Indicated and inferred reserves	2.80 billion barrels ¹
Total	4.30 billion barrels
NATURAL GAS	
Remaining Resources (January 1, 1991)	
Discovered (Includes 23 trillion cubic feet (TCF) of methane ¹ and 12 TCF of CO ₂ and He ³)	34.1 trillion cubic feet
Undiscovered (Includes 58 TCF of conventional methane ¹ ; 7 TCF of coalbed methane ⁴ ; 3,611 TCF of methane in tight gas sands in the Green River Basin ⁵ ; and 103 TCF of CO ₂ and He ³)	3,779.0 trillion cubic feet
Total	3,813.1 trillion cubic feet
Remaining Reserve Base (January 1, 1991)	
Measured reserves (Proved reserves) (Includes 11.3 TCF of methane ² and 11.7 TCF of CO ₂ and He ³)	22.1 trillion cubic feet
COAL	
Remaining Resources (January 1, 1991)	
Identified and Hypothetical (Discovered)	1,431.0 billion tons ⁶
Speculative (Undiscovered)	31.5 billion tons ⁶
Total	1,462.5 billion tons
Remaining Reserve Base (January 1, 1991)	
Demonstrated strippable (Measured and indicated reserve base)	26.4 billion tons ⁷
Demonstrated underground-minable (Measured and indicated reserve base)	38.3 billion tons ⁷
Total	64.7 billion tons
TRONA	
Original Resources (1990 estimate)	
Trona	81.0 billion tons ⁸
Mixed trona and halite	52.7 billion tons ⁸
Total	133.7 billion tons
URANIUM	
Remaining Resource (December 31, 1989)	
	1.99 billion pounds U ₃ O ₈ ⁹
Remaining Reserve Base (December 31, 1989)	
Uranium oxide recoverable at \$30.00 per pound	66 million pounds ⁹
OIL SHALE	
Original Resources (January 1, 1983)	
Identified (Discovered)	320 billion barrels of shale oil ¹⁰

¹ Modified from Barlow, J.A., Jr. and Doelger, M.J., 1983, Wyoming mineral resources: Barlow and Haun, Inc., Casper, 14 p.

² Modified from Energy Information Administration, 1990, U.S. crude oil, natural gas, and natural gas liquids reserves: 1989 Annual Report, October.

³ Derived from Exxon information.

⁴ De Bruin, R.H., and Jones, R.W., 1990, Coalbed methane in Wyoming: Geological Survey of Wyoming, Public Information Circular 30, 15 p.

⁵ Law, B.E., and others, 1989, Estimates of gas resources in overpressured low-permeability Cretaceous and Tertiary sandstone reservoirs, Greater Green River Basin, Wyoming, Colorado, and Utah: Wyoming Geological Association, 40th Annual Field Conference Guidebook, Casper, Wyoming p. 39-61.

⁶ Modified from Wood, G.H., Jr. and Bour W.V., III, 1988, Coal map of North America: U.S. Geological Survey Special Geologic Map, 1:5,000,000 scale (color) and 44 p. pamphlet.

⁷ Geological Survey of Wyoming, July, 1991. (Modified from Berryhill, H.L., Jr. and others, 1950), Coal resources of Wyoming: U.S. Geological Survey Circular 81, 78 p.

⁸ Modified from 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.

⁹ Energy Information Administration, 1989, Uranium industry annual: U.S. Department of Energy Report DOE/EIA-0478(89), 121 p.

¹⁰ 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.

GEOLOGIC MAPPING AND STRATIGRAPHY

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

Geologic road signing project continues

The Geologic Mapping Division of the Geological Survey of Wyoming (GSW) recently met with Michael Flynn of Sheridan College to provide input into a geologic signing project for U.S. Highway 16 between Buffalo and Tensleep. Outcrops of the Tertiary Wasatch Formation, the Pennsylvanian Tensleep Sandstone, the Mississippian Madison Limestone, the Ordovician Bighorn Dolomite, the Cambrian Gros Ventre Formation, and Precambrian gneiss were selected for signing. The Wyoming Highway Department will construct and install the signs, which will show each formation name and its age. The signs will be in place next summer.

Michael Flynn, with assistance from the GSW, previously located geologic road signs on the east side of the Bighorn Mountains along U.S. Highway 14. This project, as well as the one described above, is part of an ongoing effort by the Wyoming Geological Association's Highway Signs Committee, chaired by Flynn. The next project, which includes U.S. Highway 14 east of Shell to Burgess Junction, should also be completed next summer.

Rare dinosaur skeleton found near Greybull

Commercial fossil collectors working for a private Swiss company discovered the skeletal remains of a 150 million year old *Allosaurus* near the foot of the Bighorn Mountains, northeast of Greybull. The skeleton was found up to five feet below the surface in the Jurassic Morrison Formation. An adult *Allosaurus* was similar in appearance to the Late Cretaceous *Tyrannosaurus rex* only smaller, attaining a length of 40 feet and weighing about two tons. This particular carnivorous dinosaur was a sub-adult, somewhat over half-grown and about 20-25 feet in length. Paleontologists feel examination of this specimen could yield information relating to allosaur growth. The find is especially rare in that the skeleton is virtually complete and the bones are articulated (attached to one another). According to Brent Breithaupt, curator of the University of Wyoming's Geology Museum, the find represents the most complete carnivorous dinosaur skeleton ever found in Wyoming.

Because the remains were found on Federal land, the U.S. Government was responsible for determining what would be done with the find. The U.S. Bureau of Land Management (BLM), charged with responsibility for these Federal lands, announced that the specimen would be excavated by a joint paleontologic team from the University of Wyoming's Geology Museum and the Montana State University under a cooperative agreement with the BLM. The skeleton will be housed at the Museum of the Rockies in Bozeman.

Preliminary examination of the exposed skeleton by a team of scientists advising the BLM indicated that the bones would deteriorate quickly from exposure to the elements and that they should be removed before winter weather set in. The Montana State team, with assistance from Brent Breithaupt, were completing casting and removal of the bones as of October 4th. After the *Allosaurus* is transported to Bozeman, it will take two to three years to clean and preserve the skeleton and to make molds and casts. A full cast will go to the University of Wyoming's Geology Museum for research and display.

This discovery occurred in the general vicinity of the famous Howe quarry, excavated by a team from the American Museum of Natural History under the leadership of Barnum Brown in 1934. The team removed numerous Jurassic plant-eating dinosaurs from that site and shipped them back east. This most recent discovery along with the finds in the Howe quarry indicate this is indeed a dinosaur-rich area.

On a related note, the Swiss team also found samples of fossilized, dinosaur skin impressions in the area. This find could aid scientists in constructing a better picture of what dinosaurs really looked like.

Ongoing and recently completed mapping projects in Wyoming

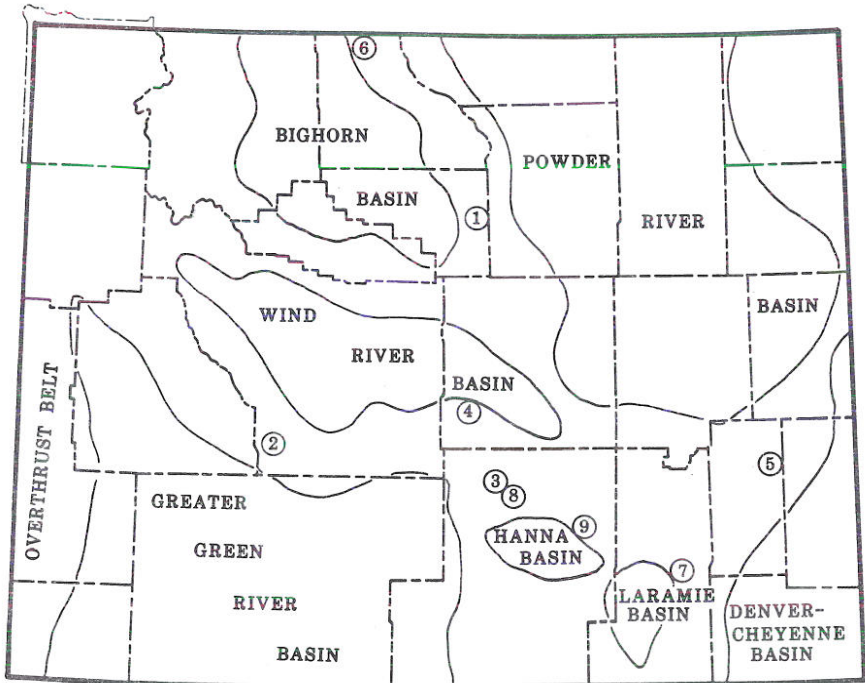
Several geologic mapping projects (1:24,000-scale) are currently in progress or were recently completed for Wyoming. The projects are summarized below. The number preceding each discussion refers to the location shown on the index map in Figure 15.

1. The Geologic Mapping Division of the Geological Survey of Wyoming (GSW) has completed nine quadrangles (listed below Figure 15) and has an additional seven in progress in the southern Bighorn Mountains. The Division is mapping these quadrangles to fill in gaps in the Nowater Creek and Kaycee 1:100,000-scale maps, which are currently being compiled for publication. (see *Wyoming Geo-notes No. 30*, p. 58-59 and *Wyoming Geo-notes No. 27*, p. 38).

2. The Metals and Precious Stones Division of the GSW recently completed a mapping project in the South Pass area. The Division mapped a total of eight quadrangles (listed below Figure 15). This mapping was part of a project culminating in Report of Investigations 44 - *Geology and mineralization of the South Pass granite-greenstone belt, southern Wind River Range, Wyoming*. This report includes a 1:48,000-scale color map of the South Pass area.

3. The Metals and Precious Stones Division also completed work on the Bradley Peak Quadrangle in the Seminoe Mountains area (listed below Figure 15). This mapping is part of an ongoing study evaluating precious metal potential in the area (*Wyoming Geo-notes No. 30*, p. 47-48).

4. The Metals and Precious Stones Division is planning a mapping project in the Rattlesnake Hills/Granite Mountains area. The project should result in the



GEOLOGICAL SURVEY OF WYOMING, 1991

Figure 15. INDEX OF ONGOING AND RECENTLY COMPLETED MAPPING PROJECTS IN WYOMING.

Available Maps

Bighorn Mountains project

- OFR 87-4 Mayoworth Quadrangle
- OFR 87-5 Red Fork Powder River Quadrangle
- OFR 88-4 Fraker Mountain Quadrangle
- OFR 88-5 Barnum Quadrangle
- OFR 88-6 Barnum Quadrangle
- OFR 89-5 Tallon Springs Quadrangle
- OFR 89-6 Turk Springs Quadrangle
- OFR 91-4 Beartrap Meadows Quadrangle
- OFR 91-5 Monument Hill Quadrangle

South Pass project

- OFR 86-26 Anderson Ridge Quadrangle
- OFR 87-10 Miners Delight Quadrangle
- OFR 88-2 South Pass City Quadrangle
- OFR 88-3 Lewiston Lakes Quadrangle
- OFR 88-8 Halls Meadow Spring Quadrangle
- OFR 88-12 Louis Lake Quadrangle
- MS-26 Radium Springs Quadrangle
- MS-28 Atlantic City Quadrangle

Seminole Mountains project

- OFR 91-3 Bradley Peak Quadrangle

mapping of at least one 1:24,000-scale quadrangle (Barlow Gap Quadrangle). The Division is evaluating the precious metal potential of the Tertiary intrusions in the area (*Wyoming Geo-notes No. 31*, p. 32-33).

5. The Industrial Minerals and Uranium Division of the GSW is currently working on a project in the Guernsey area. This mapping project is related to work the Division has been doing in the area relative to locating decorative stone. The Division will produce a 1:24,000-scale map of the Guernsey Quadrangle.

6. The Industrial Minerals and Uranium Division has mapped a portion of the Natural Trap Cave Quadrangle (1:24,000-scale) as part of an evaluation of the silica sand potential in the John Blue canyon area. The map will be included in the resulting report.

7. B.R. Frost of the University of Wyoming's Department of Geology and Geophysics and G.L. Snyder of the U.S. Geological Survey are leading a geologic mapping program in the Laramie anorthosite complex. Participants include Donald Lindsley of the State University of New York at Stony Brook and Jeremy Mitchell and James Scoates, graduate students in the University of Wyoming's Department of Geology and Geophysics. The Sybille Springs, Sheep Rock, Guide Rock, and Moonshine Peak quadrangles are finished, but not published. Work continues on the Poe Mountain, Baldy Mountain, Goat Mountain, and Indian Guide quadrangles. These maps will be published by the U.S. Geological Survey.

8. A.W. Snoke of the University of Wyoming's Department of Geology and Geophysics and Nancy Bowers and Diedra Bohn, graduate students in the Department's M.S. program, are mapping in the Seminoe Dam area. Bowers is mapping portions of the Spanish Mine, Buzzard Ranch, Ferris, and Bradley Peak quadrangles. Bohn is mapping on the Seminoe Dam NE, Beaver Creek, Seminoe Dam SE, and Schneider Ridge quadrangles.

9. J.A. Lillegraven of the Department of Geology and Geophysics at the University of Wyoming is currently mapping features within the Eocene Hanna Formation on the north side of the Hanna Basin. He has mapped portions of "The Breaks", in the Como West Quadrangle.

The Geologic Hazards Division of the GSW has completed the mapping of landslides on over 850 1:24,000-scale quadrangle maps in Wyoming. The project, which began in 1983, entailed the mapping or remapping of all landslide-prone areas in the State. Over 420 of the quadrangles have been published as Preliminary Landslide Maps. The Division also completed a 1:1,000,000-scale landslide map which provides a statewide overview (OFR 91-1). Sixteen 1° x 2° quadrangles at a 1:250,000-scale have recently been published as OFR 91-2A through 2P (*Wyoming Geo-notes No. 30*, p. 62-63).

GEOLOGIC HAZARDS

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

Radon in Wyoming Soils and Bedrock

The Geologic Hazards Division of the Geological Survey of Wyoming (GSW) has received a \$28,600 grant from the U.S. Environmental Protection Agency and the Wyoming Department of Health. With these funds, the GSW will initiate a program to test for the presence of radon in selected soils and bedrock in Wyoming. Most soils and rocks contain some small concentrations of uranium and radium, the decay of which will produce radon. An ability to identify soils and rocks that have the greatest potential to generate or transmit radon will be of use to any home sampling program.

In Wyoming, soil composition is in large part related to the type of bedrock present in the vicinity of the soil. If bedrock is enriched in uranium or radium, the soils derived from it may also be enriched (Reimer, 1990). The bedrock sources for windblown and alluvial deposits can also have a significant effect on the soils associated with those transported materials. Geomorphic features in an area, such as hillcrests, valleys, terraces, and landslides, also have an effect because they affect soil type and composition.

The quantity of radon that is released to the atmosphere from soil, however, can be drastically affected by the moisture, permeability, temperature, and composition of the soil that the radon has to pass through. In addition, there are factors not directly associated with soil, such as barometric pressure and wind speed, that can also affect the rate at which radon is released to the atmosphere.

Recent research by Asher-Bolinder, Owen, and Schumann (1990) indicates that daily and seasonal variations in soil-gas radon levels at one site can be significant. And it is not known at this time if relationships observed during one soil-gas radon traverse are repeatable during the course of a year.

The GSW will examine the viability of using soil-gas radon traverses to flag geologic formations, geomorphic features, and soils for their capacity to generate or emit radon. Two traverses, each crossing distinct geologic formations and features, will be established in Albany County. Data on soil-gas radon, soil temperature, soil moisture, soil permeability, background gamma radiation, and barometric pressure will be collected at each sample site along each traverse. The traverses will be repeated weekly for a year as weather permits.

Soil-gas radon samples will be collected using probe and analysis techniques developed by M. Reimer and R. Schumann of the Denver office of the U.S. Geological Survey. Because of the many variables that can affect the radon levels in soil-gas measurements at a given time or place, the emphasis will be on determining the repeatability of relative rather than absolute radon values.

Data collected along each traverse will be compared from one sampling period to another, and a summary of findings will be prepared in Fiscal Year 1993. If the observed relationships between geologic formations, geomorphic features, and soils are reproducible, the GSW will conduct soil-gas radon traverses in other areas of the State with the hope of compiling generalized radon-potential maps. For further information, contact J.C. Case at the Geological Survey of Wyoming.

References cited

- Asher-Bolinder, S., Owen, D.E., and Schumann, R.R., 1990, Pedologic and climatic controls on RN-222 concentrations in soil gas, Denver, Colorado: *Geophysical Research Letters*, v. 17, No. 6, pp. 825-828.
- Reimer, G.M., 1990, Reconnaissance techniques for determining soil-gas radon concentrations: an example from Prince Georges County, Maryland: *Geophysical Research Letters*, v. 17, No. 6, pp. 809-812.

WYOMING BOARD OF PROFESSIONAL GEOLOGISTS

The Wyoming Board of Professional Geologists gave notice in late October that it intended to adopt rules under which it will operate as it administers the licensing law for geologists seeking to use the title of "professional geologist" in Wyoming (W.S. 33-41-101 through 33-41-121). These rules prescribe the organization, responsibilities, and duties of the Board; provisions for certification as a geologist-in-training; provisions for registration as a professional geologist; a Code of Professional Conduct; a registrant's seal; provisions for setting examination and licensing fees; required examinations; annual renewal procedures; procedures for initiating and for conducting hearings to investigate violations of the licensing law or the Board's rules to include complaints about registrants; and practices to ensure privacy of personal information.

Written comments on the proposed rules were due by November 26, 1991, and the public hearing on the proposed rules was set for December 5, 1991, at 10 a.m. at the Basko Building, 777 West 1st Street, Casper, Wyoming. Once the rules are adopted, the Board can proceed with mailing out applications to those individuals who have already expressed interest in registering. In early November, over 1,600 people were on the mailing list. It is anticipated that applications might be mailed out by the first of the year.

Those interested in registering as a professional geologist in Wyoming must have a completed application into the Board by June 30, 1992, if they wish to take advantage of the "grandfather clause". After that date, registration will require examinations.

To be added to the list of individuals desiring applications, send your name, address, and phone number to:

Wyoming Board of Professional Geologists
P. O. Box 3008, University Station
Laramie, Wyoming 82071

Or call Patricia Kessler at (307) 766-2286.

REORGANIZATION PLAN FOR THE GEOLOGICAL SURVEY

During the last Legislative Session, the Geological Survey was designated a "separate operating agency" instead of being put into a proposed new Department of Natural Resources. In preparation for this year's Legislative Session, two joint committees of the Legislature have held hearings on a new reorganization proposal that would combine the Geological Survey and the Oil and Gas Conservation Commission into a cabinet-level agency called the Department of Mineral Resources.

Under this reorganization plan, the two agencies would become divisions of the new department and they would retain most, if not all, of their present duties and responsibilities. In addition, a new Minerals Advisory Board would be created to advise the Director of the new agency on mineral- and energy-related matters.

NEW PUBLICATIONS

Coal map of Wyoming, by R.W. Jones: Map Series 34, 1991, 1:500,000 (color) - \$10.00 folded (\$11.50 mailed rolled).

Oil and gas map of Wyoming, by R.H. De Bruin and C.S. Boyd: Map Series 35, 1991, 1:500,000 (color) - \$10.00 folded (\$11.50 mailed rolled).

Oil and gas fields map of the Greater Green River Basin and overthrust belt, southwestern Wyoming, by Robert W. Gregory and Rodney H. De Bruin: Map Series 36, 1991, 1:316,800 (color) - \$4.00 folded (\$5.50 mailed rolled).

*Oil and gas fields map of the Wind River Basin, by Rodney H. De Bruin and Stephen D. Hostetler: Map Series 37, 1991, 1:316,800 (color) - \$4.00 (\$5.50 mailed rolled).

Preliminary landslide maps, by J.C. Case and others: call for the availability of particular 1:24,000- and 1:62,500-scale maps, 1989-1991 - \$3.00.

Landslide map of Wyoming, by J.C. Case, L.L. Larsen, L.A. Coombs, D.R. Gilmer, T.C. Nissen, J.A. Ford, J.C. Cannia, and W.B. Murray: Open File Report 91-1, 1991, 1:1,000,000 - \$4.00.

- 1° x 2° quadrangle landslide maps of Wyoming, by J.C. Case, L.L. Larsen, L.A. Coombs, D.R. Gilmer, T.C. Nissen, J.A. Ford, J.C. Cannia, and W.B. Murray (authorship on individual maps varies): Open File Report 91-2A through 91-2P, (sixteen maps), 1991, 1:250,000 - \$4.00.
- Precambrian geology map of the Seminoe Mountains (iron-gold) mining district, Bradley Peak Quadrangle, Carbon County, Wyoming, by W.D. Hausel: Open File Report 91-3, 1991, 1:24,000 - \$3.50.
- Preliminary geologic map of the Beartrap Meadows Quadrangle, Johnson County, Wyoming, by A.J. Ver Ploeg and P.L. Greer: Open File Report 91-4, 1991, 1:24,000 - \$3.50.
- Preliminary geologic map of the Monument Hill Quadrangle, Washakie and Johnson Counties, Wyoming, by A.J. Ver Ploeg and P.L. Greer: Open File Report 91-5, 1991, 1:24,000 - \$3.50
- Decorative stones of Wyoming, by Ray E. Harris: Public Information Circular 31, 1991 - \$5.00.
- Geology and mineralization of the South Pass granite-greenstone belt, southern Wind River Range, Wyoming, by W.D. Hausel: Report of Investigations 44, 1991 - \$20.00 (map is also available separately for \$5.00).
- Results of coal drilling projects in the Wind River Coal Field, Wyoming, by R.W. Gregory, R.W. Jones, and Gary B. Glass: Report of Investigations 46, 1991 - \$5.00.
- Tectonic relationships of the southeastern Wind River Range, southwestern Sweetwater uplift, and Rawlins uplift, Wyoming, by D.L. Blackstone, Jr: Report of Investigations 47, 1991 - \$10.00.
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* 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.

No first class postage charge for prepaid orders, unless otherwise marked.

— NEW SERVICE AVAILABLE —

By special arrangement with the Wyoming Geological Association (WGA), the Geological Survey of Wyoming now sells all of WGA's Annual Field Trip Guidebooks as well as its Symposium Volumes. These publications are available over-the-counter at the Survey's offices on the University campus in Laramie. Although they can be purchased by mail, prepayment is required. Call the Survey for book prices and postage costs. WGA sale prices will be honored also.

GEOLOGICAL SURVEY OF WYOMING LOCATION MAPS

