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

WYOMING GEO-NOTES NO. 9

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WYOMING GEO-NOTES

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

Wyoming Geo-notes was first published in July, 1977, as a semiannual newsletter for the Geological Survey. It had a very shaky start which ended abruptly with a single issue, designated Volume 1, Number 1. The recent success of our quarterly *Minerals Update for Wyoming*, however, has been so overwhelming that it now forms the backbone for our rejuvenated Wyoming Geo-notes. The newsletter is now published quarterly and has been expanded to include news about Staff and Survey activities.

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TABLE OF CONTENTS

MINERALS UPDATE

OVERVIEW

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

With the calendar year nearly over, there is good news relative to some mineral production in Wyoming. The price of oil has remained steady, continuing the trend reported last September. Oil production has also rebounded slightly, and our forecast of 125 million barrels may be exceeded. Coal production is also doing even better than forecast in September. Although no final numbers are available, it now looks like production from Wyoming's coal mines might exceed 145 million tons and register a 10-11 percent gain over last year's record 130.7 million tons. Spot sales of coal still dominate this boost in production. In regard to coal prices, recent spot sales from the Powder River Coal Basin have been as low as $4.98 and $4.50 per ton (FOB mine), respectively.

Production of Wyoming's other major minerals (natural gas, uranium, trona, and bentonite) are tracking our September forecasts although end of the year declines in natural gas production are reported, and the average price for natural gas has fallen substantially in parts of the State.

The greatest concern however, is in regard to oil and gas drilling activity. As expected, drilling for natural gas has not improved, but more importantly, the traditional year-end increase in oil and gas drilling has apparently not materialized in 1985. Evidently, reduced drilling budgets have been substantial enough that budgets were depleted before the end of the year, and there has been no need to significantly increase drilling activity to work off surplus budgets.

The concern over this latter item is obvious. Without this late year boost in drilling, the State's

Wyoming mineral production forecast to 1991[1].

Calendar Year	Oil Production[2]	Natural Gas Production[3]	Coal Production[4]	Trona Production[4]	Uranium Production[4]
*1981	122.1	455.4	102.8	11.8	4.6
*1982	118.7	465.1	107.9	10.1	2.1
*1983	120.9	539.7	112.2	10.5	3.0
*1984	127.8	600.1	130.7	11.0	1.6
1985	125.0	630.0	145.0	11.3	0.9
1986	124.0	675.0	148.0	11.4	0.3
1987	122.0	715.0	149.5	11.5	0.3
1988	120.0	800.0	151.5	11.6	0.3
1989	118.0	825.0	152.0	11.7	0.3
1990	116.0	875.0	152.0	11.8	0.3
1991	114.0	925.0	152.0	12.1	0.3

*Actual values for comparison, [1] Geological Survey of Wyoming, December, 1985, [2] in millions of barrels, [3] in billions of cubic feet, [4] in millions of tons.

drilling activity could be below last years. This ultimately translates into declining reserves since it takes drilling to find oil and gas, and the lead time in converting new discoveries into reserves makes a rapid reversal of this trend unlikely. Pending Federal legislation still hanging over the petroleum industry, the continuing gas glut, and questions about the long term stability of oil prices are all working to tone activity down, and unfortunately, hold it down, at least in the near term.

This issue of *Geo-notes* also reflects the cessation of metals exploration as winter closes off access to most of the State's metalliferous areas. The growing demand for Wyoming's by-product sulfur, however, is another bright spot and is highlighted on pages 33 to 36.

METALS AND PRECIOUS MINERALS UPDATE

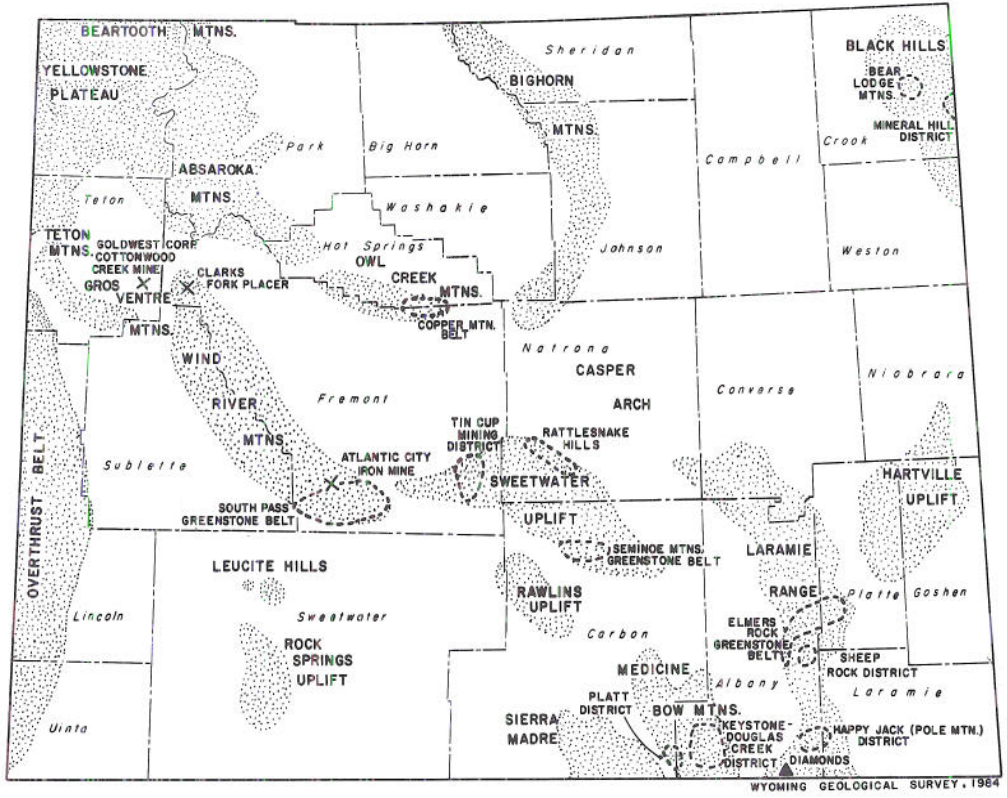
by W. Dan Hausel, Deputy Director, Geological Survey of Wyoming

According to the October issue of *PAY DIRT*, AMAX Incorporated has placed its Kirwin property on the selling block. The Kirwin property lies southwest of Meeteetse, Wyoming, in the southern Absaroka plateau. Kirwin is one of the several untapped porphyry copper-molybdenum deposits found in northwestern Wyoming. In 1979, the U.S. Bureau of Mines estimated that the Kirwin area contained a resource of at least 70 million short tons of 0.75 percent copper. *PAY DIRT* reported the porphyry could yield 615,000 tons of copper, 13,500 pounds of molybdenum, 121,000 ounces of gold, and 5.6 million ounces of silver.

At one point, AMAX had planned to operate a large open pit mine at Kirwin, beginning in 1980. But with the decline in copper and molybdenum prices, AMAX's plans were canceled. More information about the area is available in papers by Wilson (1964) and Hausel (1982).

The Dow-Jones News Service earlier this year reported that Lac Minerals Ltd., which is operating in the Colorado-Wyoming State Line diamond district, is offering 500 carats of diamonds for sale. The diamonds were extracted from one 3,000-ton bulk sample of kimberlite from the Colorado side of the State Line District. This is equivalent to a grade of 0.17 carat per ton. Average kimberlite ore, world-wide, runs about 0.25 carat per ton.

The Geological Survey of Wyoming is continuing its kimberlite exploration project in Wyoming. Sample concentrates from stream sediments collected from the Laramie Range during this past field season are being processed for kimberlitic indicator minerals. During the past field season, sampling was confined to the Pole Mountain area and the Elmers Rock greenstone belt in the central Laramie Range.



REGIONS OF EXPLORATION ACTIVITY FOR STRATEGIC MINERALS

The project area has also been expanded to the Green River Basin to test lamproite from diamond in the Leucite Hills area, and to search for the origin of pyrope garnet and chrome diopside found in anthills near Cedar Mountain. The Cedar Mountain anomaly is located south of Granger, and nearly 50 miles southwest of the Leucite Hills.

The Metallic and Precious Minerals Section of the Geological Survey is cataloguing reports and maps on gold deposits at South Pass and is updating maps of this greenstone belt area. Three reports on this area have been completed. The reports (Hausel, 1985, 1986a, and 1986b) were submitted for publication and are general overviews on the geology and gold mineralization of South Pass.

These reports describe South Pass as a fragmented greenstone terrain with at least four mappable units. The lowermost unit is an ultramafic to mafic metavolcanic layer. This lowermost unit is overlain by a quartzite-metapelite-iron formation layer that is overlain by a metatholeiitic unit. The metavolcanic unit is in fault contact and overlain by a thick succession of metagreywackes with lesser calc-alkaline metavolcanics. Rocks of this youngest Precambrian supracrustal group are dated at about 2.8 billion years old, which may be a metamorphic date.

Mapping from the past field season is still being compiled, thin sections are being analyzed, and the results of several assays and analyses of whole rock samples will soon be available. In addition to the work completed on three 7½-minute quadrangles (see *Geo-notes No. 8*), nineteen mine maps of historic gold mines have been completed. One mine, the Snowbird, is quite unique.

The Snowbird Mine, in the South Pass-Atlantic City District, was developed on a 40 to 50 feet wide carbonated and silicified stratabound zone hosted by metavolcanics. The zone contains massive sulfides (pyrite and minor chalcopyrite). A model lead age date from

the ore body reported by Bayley and others (1973) was 1.75 billion years. One sample of a calcite-rich quartz vein, collected at the surface by Prinz (1974), assayed 4.5 ppm gold.

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OIL AND GAS UPDATE

by Alan J. VerPloeg, Petroleum Geologist, Geological Survey of Wyoming

The U.S. Department of Energy recently published its 1984 year-end reserve estimates for the United States and the individual oil and gas producing states (U.S. Energy Information Agency, 1985). For the first time in 14 years, the proved reserves of crude oil in the United States increased, roughly 2.6 percent, to 28.4 billion barrels. Natural gas reserves declined 1.4 percent to 197.5 trillion cubic feet.

Reserve figures for Wyoming increased for gas and decreased slightly for oil according to the report. Wyoming was credited with 954 million barrels of oil at year-end 1984 as compared to 957 million barrels at year-end 1983 (see table on page 22). This represents the fifth highest oil reserve among producing states. The total for gas reserves increased to 10.58 trillion cubic feet from the 1983 year-end total of 10.23 trillion, which makes Wyoming's reserves the seventh highest among producing states and 41.9 percent of the Rocky Mountain region's reserves (see table on page 22).

The U.S. Bureau of Land Management's lease sale held October 30th drew high bids totaling $1,876,104.84 for 32,052 acres. Only 105 tracts out of a total of 208 received bids. The average bid per acre was $58.53 (Petroleum Information Corporation Rocky Mountain Region Report, 11-6-85, p. 13-14). Exxon Corporation's bid of $1,108.77 on Tract #206 was the highest bid offered. This 520-acre lease in the southwestern part of the State, 2.5 miles west of Luckey Ditch Field, already produces gas from the Dakota. For a comparison with past sales, see table on p. 8.

WYOMING FEDERAL AND STATE COMPETITIVE OIL AND GAS LEASE SALES

BLM SALES 1984

Month	Total Revenue	Number of parcels offered	Number of parcels sold	Total acres	Acres sold	Average price per acre sold	High price per acre
February	$ 7,262,056	21	21	2,304	2,304	$3,151.31	$21,239.34
March	615,088	28	28	4,015	4,015	153.20	500.00
April	330,798	29	29	3,977	3,977	83.17	412.51
May	1,571,896	77	75	14,565	14,470	108.63	1,300.00
August	12,465,683	162	162	30,110	30,110	414.00	13,333.33
October	2,521,434	115	115	19,852	19,852	127.01	3,852.00
December	4,761,794	123	123	29,202	29,202	163.07	5,751.50
TOTAL	$29,528,749	555	553	104,025	103,930	$ 284.12	$21,239.34

1985

February	$ 3,547,273	117	115	34,948	34,028	$ 104.24	$ 1,700.00
April	2,025,793	133	128	25,497	24,056	84.21	2,609.53
June	1,963,897	140	137	40,304	38,904	50.48	2,577.15
August	2,854,821	190	146	75,094	56,906	50.17	1,732.14
October	$ 1,876,105	208	105	81,611	32,052	$ 58.53	$ 1,108.77

STATE SALES 1983

Month	Total Revenue	Number of parcels offered	Number of parcels sold	Total acres	Acres sold	Average price per acre sold	High price per acre
August	$ 2,604,676	88	88	43,262	43,262	$ 59.21	$ 479.00
October	1,875,687	100	86	52,412	42,891	42.73	290.04
TOTAL	$ 4,480,363	188	174	95,674	86,153	$ 52.00	$ 479.00

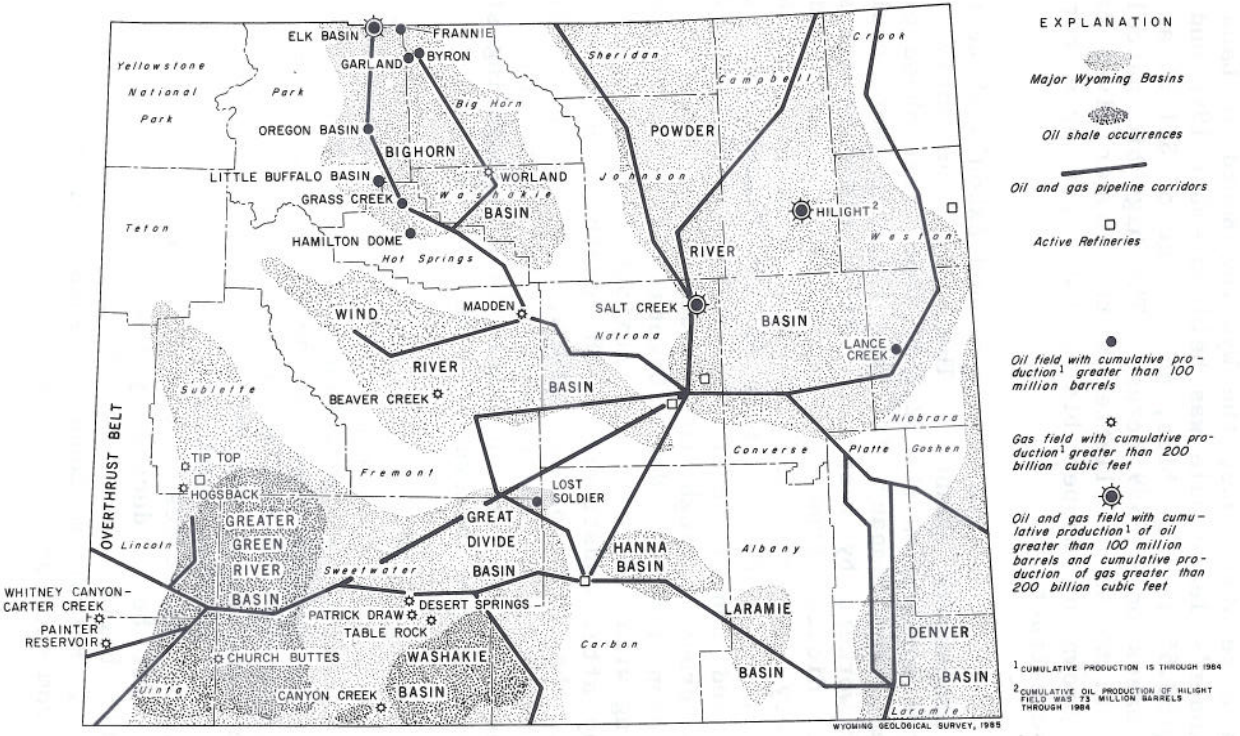
1984

January	$ 2,316,714	200	165	118,285	92,785	$ 23.97	$ 502.04
March	2,173,851	200	166	85,993	66,781	31.49	524.00
May	1,527,903	200	162	87,469	67,579	32.49	390.00
July	2,028,880	200	181	86,387	73,849	26.46	2,100.00
September	1,379,138	200	141	87,095	53,066	24.99	1,020.00
November	739,766	200	135	82,363	51,640	13.33	280.00
TOTAL	$10,166,252	1,200	950	547,592	405,700	$ 25.05	$2,100.00

1985

January	$ 757,214	200	86	80,019	27,520	$ 26.51	$1,700.00
March	2,077,478	300	172	137,321	69,781	29.77	1,600.00
May	936,374	199	117	73,625	35,273	26.55	350.00
July	636,350	200	113	83,491	43,630	14.59	280.00
September	989,069	200	126	95,052	60,356	16.39	325.00
November	$ 494,739	200	109	70,144	41,399	$ 11.95	$ 320.00

Sources: Wyoming Department of Public Lands and Petroleum Information Corporation - Rocky Mountain Region Report



GENERALIZED OIL AND GAS INDEX MAP OF WYOMING

EXPLANATION

Major Wyoming Basins

Oil shale occurrences

Oil and gas pipeline corridors

Active Refineries

Oil field with cumulative production[1] greater than 100 million barrels

Gas field with cumulative production[1] greater than 200 billion cubic feet

Oil and gas field with cumulative production[1] of oil greater than 100 million barrels and cumulative production of gas greater than 200 billion cubic feet

[1] CUMULATIVE PRODUCTION IS THROUGH 1984

[2] CUMULATIVE OIL PRODUCTION OF HILIGHT FIELD WAS 73 MILLION BARRELS THROUGH 1984

On a related note, the Wyoming Board of Land Commissioner's lease sale was held November 19th and drew $494,738.55 in high bids, an average of $11.95 an acre for leases on 41,399 acres. The high-bid parcel was Tract #1165 near Gillette in the Powder River Basin. Gary Brown of Casper bid $320.00 per acre for the 7.8-acre tract.

News continues to center around Exxon's Shute Creek gas processing plant. There are currently 6,500 workers working on the $2.2 billion first phase of the project, and company officials indicate there could be 7,200 workers by year-end. Exxon plans to transport carbon dioxide from this large plant to enhanced oil recovery projects in Colorado, Wyoming, and North Dakota. Recently ranchers in the Powder River Basin expressed concern over the proposed pipeline, which would cross through the Powder River Basin to the Williston Basin in North Dakota. They feel problems dealing with the control of noxious weeds on the right-of-way after construction, the depth of burial of the line, the right-of-way width, and Exxon's initial contract with landowners need to be dealt with. Exxon states that they are currently in a negotiating stage, and all rancher concerns will be considered.

According to a study by the Interstate Oil Compact Commission (IOCC), enhanced oil recovery (EOR) methods could generate an additional $500 million in state taxes for Wyoming over the next several years. An estimated 400 million barrels of additional oil could be realized using currently feasible EOR techniques. This IOCC project began last spring, and recently all oil producing states were invited to participate. The study will be conducted by Lewin and Associates Inc. It will build upon data already available from the National Petroleum Council, incorporating production data from each participating state.

In a report released by the Interstate Oil Compact Commission, the role of stripper wells (wells only capable of producing ten or less barrels of oil per day) in the United States' oil production was profiled.

In 1984 stripper wells produced 463,459,000 barrels of oil, a 1.4 million barrel increase over 1983 and roughly 15 percent of the Nation's total production. Stripper's in 1984 averaged less than three barrels per day, compared to the National average of 14 barrels per day. However, it was also noted that over 14,000 of these wells were abandoned during the year due to the fact that production in many wells had dropped to such a small amount that taxes, royalties, and operating expenses could not be covered. In the case of Wyoming in 1984, 5,020 stripper wells produced 7,118,844 barrels of oil. Average production was 3.87 barrels per day. Wyoming's stripper well reserves were estimated at 170,500,000 barrels. Production trends for Wyoming stripper wells are shown in the table below:

Stripper Well Production in Wyoming

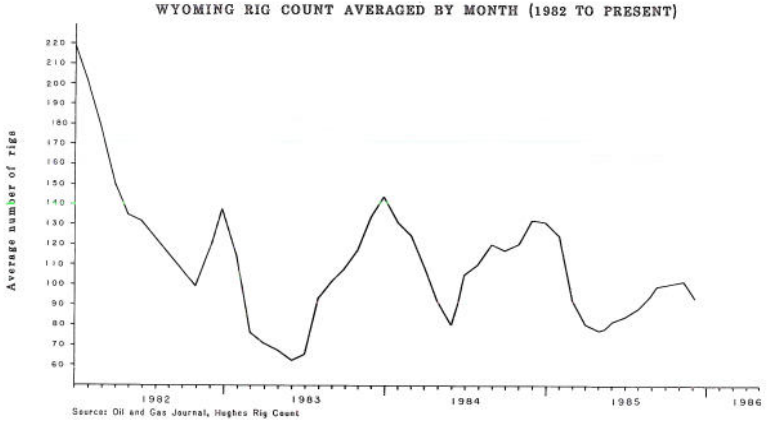
	Number of Stripper Wells	Production
1981	3,349	5,366,854
1982	4,792	6,354,517
1983	5,020	6,944,013
1984	5,020	7,118,844

Source: National Stripper Well Survey, IOCC, 1985.

Most notably, the number of stripper wells in Wyoming did not increase from the number in 1984. Soft oil demand and increased operator costs, probably account for this plateau in well count.

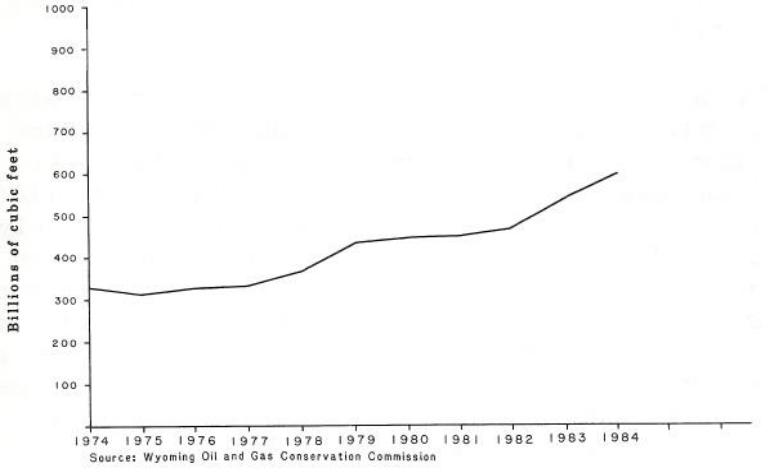
Mitchell Energy and Development Corporation recently announced that they plan to initiate a pilot waterflood in Mikes Draw Field in the Powder River Basin. The Teapot sand member of the Mesaverde Formation will be waterflooded in a 400-acre pilot project, beginning next year. This initial attempt will cost $4 million. If successful, the project will be expanded to include all of the 7,400-acre unit in the field at a cost of $28 million. Potential secondary recovery is estimated

WYOMING RIG COUNT AVERAGED BY MONTH (1982 TO PRESENT)



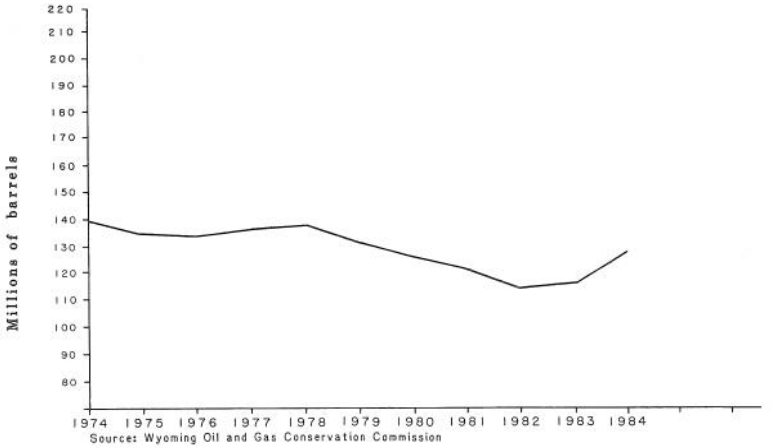
WYOMING RIG COUNT AVERAGED BY YEAR (1974 TO 1984)

WYOMING NATURAL GAS PRODUCTION BY YEAR (1974 TO 1984)



Source: Wyoming Oil and Gas Conservation Commission

WYOMING OIL PRODUCTION BY YEAR (1974 TO 1984)



Source: Wyoming Oil and Gas Conservation Commission

at 5.5-9 million barrels of 44° API gravity oil. Injection water will come from the Fox Hills Sandstone at about 5,800 feet (Oil and Gas Journal, November 11, 1985, p. 41-42).

The Wyoming Board of Equalization adopted rules in early October to govern the two percent severance tax exemption on tertiary recovery projects for oil. The rules and exemption only apply to projects certified by the Oil and Gas Conservation Commission after July 1, 1985, and before July 1, 1990. Industry spokesman had requested some wording changes in the rules. They successfully argued for the deletion of the clause disallowing the exemption for interrupted tertiary projects since many tertiary projects are cyclical due to the process used and interruptions are necessary. The new rules should go into effect before the end of the year.

Concerning the Buck Draw Field controversy, the Wyoming Oil and Gas Conservation Commission ordered operators in the north portion of the field to shut-in production and begin working on a plan for secondary or tertiary enhanced recovery. The wells in the north portion of the field were shut-in beginning October 11th. The Commission's order, however, has been appealed in District Court.

In *Geo-notes No. 7* (June, 1985, p. 16-19) mention was made of the many closures of small refineries in the Wyoming and the Rocky Mountain area. This trend is emphasized in the following table:

Number and Capacity of Wyoming Refineries, 1981-1985

	Number of Operating Refineries			Capacity (barrels per calendar year)	
	Total	Operating	Idle	Operating	Idle
1981	14	14	0	231,580	0
1982	12	10	2	209,555	20,185
1983	7	6	1	168,055	1,500
1984	6	5	1	166,855	200
1985	6	6	0	172,005	0

Source: Basic Petroleum Data Book, American Petroleum Institute, Volume II-V.

As a result of Monsanto's deep Madison discovery in the Madden Field area, other companies are beginning to look at similar plays in the area (see *Geo-notes No. 8*, September, 1985, p. 27-28). Monsanto recently staked an off-set well to the discovery, and W.A. Moncrief, Jr. announced plans to deepen a dry hole nine miles northeast of Bonneville on the same general trend. Moncrief plans to drill to 23,000 feet and test the Madison.

Mountain front overthrust areas are still in the news with Champlin recently announcing plans to drill a well to 12,000 feet in the Medicine Bow Mountains, seven miles southwest of McFadden. The well will spud in Precambrian and is targeted for sediments in the footwall of the reverse fault.

Reference cited

U.S. Energy Information Agency, 1985, U.S. crude oil, natural gas, and natural gas liquids, 1984: U.S. Department of Energy Annual Report DOE/EIA-0216/84), 98 p.

URANIUM AND INDUSTRIAL MINERALS UPDATE

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

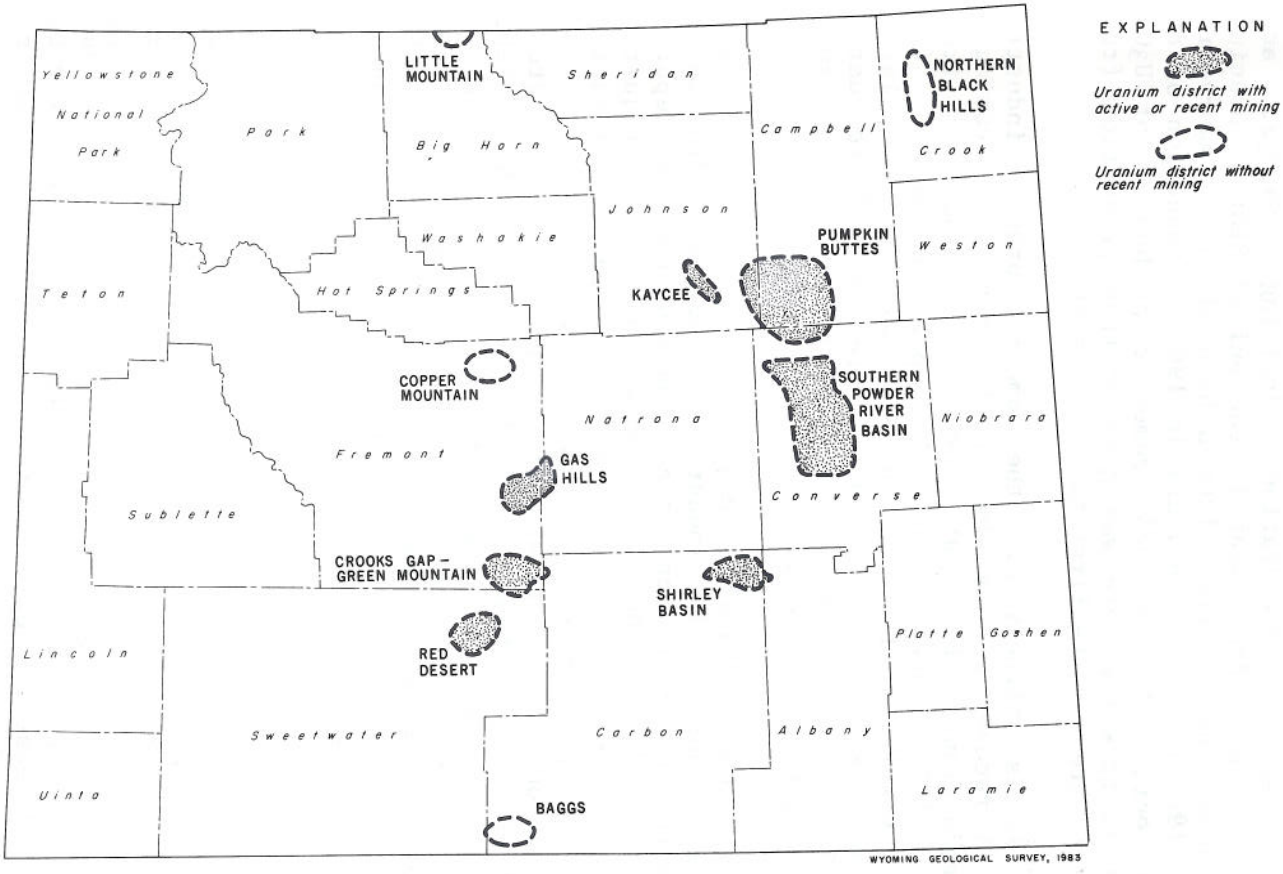
Uranium

During the fourth quarter of 1985, uranium continued to be produced in Wyoming at two locations. Bear Creek Uranium will produce uranium oxide from its Bear Creek Mine north of Douglas, through December, after which production will cease. Pathfinder Mines, owned by the French Company, COGEMA, is producing uranium oxide from its Shirley Basin Mine north of Medicine Bow. The COGEMA-Pathfinder's Lucky Mc mill and mine in the Gas Hills east of Riverton remains closed due to construction and expansion at the mill. This operation is scheduled to restart in mid-1986.

Bear Creek's production is sold to a Southern California utility (Mono Power) under a contract that terminates at the end of 1985. Production from Pathfinder-COGEMA goes to Japan where it is enriched to three percent U_{235} for French nuclear power plants (Natural uranium is about 0.7 percent U_{235}, the fissionable isotope). In 1986, all new Wyoming production will be exported.

There are no encouraging signs for increased uranium production in the United States and Wyoming. Although utilities are lowering their stocks of uranium, no new contracts have been let, and it still remains to be seen whether new contracts are made with domestic or foreign producers. During the past quarter, the spot price rose from $15.75 per pound of uranium oxide to $16.50 per pound. This is significantly down from the 1979 high of $42.00 per pound.

All indicators of uranium activity recently reported by the U.S. Energy Information Agency show declines from 1983 to 1984 (U.S. Energy Information Administration, 1985). These include exploration and development



MAJOR ACTIVE AND INACTIVE URANIUM DISTRICTS

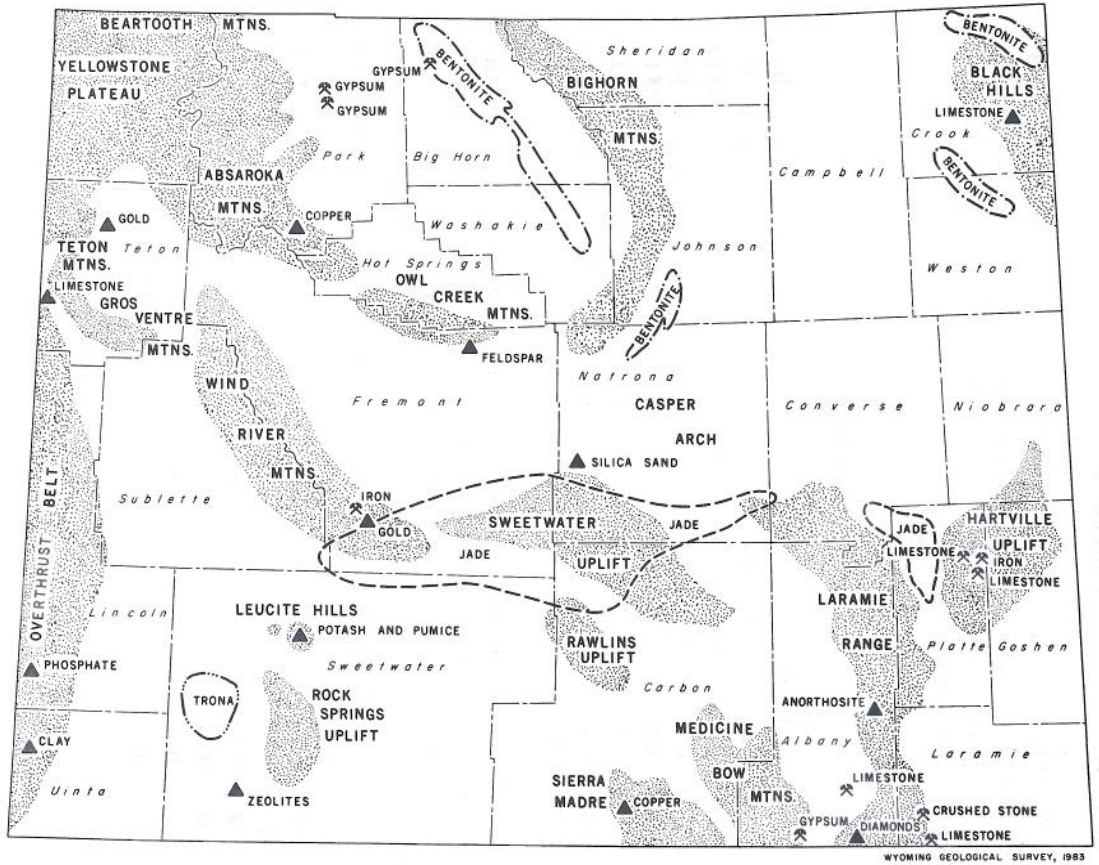
expenditures, total production, numbers of companies involved in exploration, drilling footage, and employment. Employment in the United States' uranium industry has declined from a high of 21,951 man-years in 1979 to 3,597 man-years in 1984, a reduction of 84 percent. Also in 1984, domestic production of U_3O_8 from stockpiled ore was greater than production from mined ore for the first time in history.

It is unlikely that the domestic uranium industry will recover at any time in this century. Wyoming's production will probably decline to production from COGEMA-Pathfinder's Lucky Mc operation only. (An interesting fact - the Lucky Mc was the first large mine in Wyoming, with production beginning in February, 1958 -- now it will probably be the only mine to survive into the 1990's).

At the National level, the uranium industry was deemed "not a viable industry" in 1984, according to an awaited determination recently made by the U.S. Department of Energy (DOE). The Atomic Energy Act requires the Secretary of Energy to make an annual determination of the industry's viability. Along with the determination, the Secretary of Energy, John Herrington, offered three steps to aid the industry. These steps included offering low cost enrichment services to customers purchasing 100 percent of their fuel from DOE, not selling from Government-owned uranium stockpiles, and commencement of a study of foreign uranium imports into the United States.

Bentonite

Bentonite production has remained relatively steady in 1985, but at low prices. There has been no resurgence in demand for bentonite for the main uses in taconite pelletizing, foundry castings, or, especially, well drilling mud. This trend is expected to continue into 1986. Production should remain at low levels with no increase or decrease of note. There has, however, been an increase in the use of specialty bentonite -- that used in soaps, medicines, cosmetics, etc.



SELECTED MINERAL AND ROCK OCCURRENCES

In addition to the major bentonite producers, two companies, Milwhite, Inc., and Southern Clay Products, process raw ore from Dresser-Magcobar (Greybull) and Kaycee Bentonite Partnership, respectively, for the high quality specialty bentonite used in ceramics and medicine. This production only accounted for 0.57 percent of Wyoming bentonite in 1984.

For the long term, bentonite production should increase. Growth in demand should increase prices, bringing an upturn to an industry coping with the current low demand and resultant low prices.

Trona

Trona, whose 1985 production is only slightly above 1984 levels, faces a promising future if Wyoming producers of soda ash (refined trona) can increase exports. Domestic consumption of soda ash, mainly for glass production, water softeners, chemicals, and paper whiteners, is expected to remain fairly stable. Currently, Wyoming accounts for 90 percent of the Nation's soda ash production.

World-wide demand, however, is growing at an annual rate of from six to 16 percent. The Asian market represents the best opportunity since European and other developed countries have domestic synthetic soda ash plants protected by high tariffs on imported soda ash. Mainland China, for example, represents a possible 2.5-million-ton market by 1990, according to Bruce C. Baker, trona marketing officer for Tenneco. This represents about 25 percent of the total present Wyoming production, and the increase, if it occurs, can be absorbed by the present production capacity of Wyoming plants, now operating at 70 percent capacity.

Other industrial minerals

The production of gypsum for wallboard and cement, which declines seasonally, should surpass last year's production.

The production of clay used to make bricks near Evanston is increasing, and clay was dug near Laramie for the construction of a diversion berm along the Laramie River adjacent to a chemical-waste dump site. This operation closed following the completion of the diversion.

The production of limestone for use in sugar production in Wyoming has ceased. Holly Sugar now ships only small amounts of high-calcium limestone from the Lost Day Quarry north of Fort Laramie to the Laramie River Power Station near Wheatland for use in stack scrubbers. Holly Sugar is using limestone from South Dakota in the Torrington and western Nebraska sugar refineries. Great Western Sugar, which is in receivership, has closed the L Bar F Quarry west of Cheyenne.

The use of limestone aggregate for highway construction is increasing, however, and several construction projects are currently crushing limestone for this use. The supplies of gravel in certain areas of the State, particularly Cheyenne and Casper, are being depleted both by production and by being covered by houses and buildings. Crushed stone brought in from outside is an alternative to local sources of aggregate.

Railroad production of ballast, which declined in early 1985 as new construction projects were completed, are increasing again as existing lines are repaired or upgraded. The Union Pacific Railroad continues large scale production of granitic gneiss for ballast west of Cheyenne. The Union Pacific is also using spent shale (from the production of phosphate at Leefe, west of Kemmerer) as ballast in western Wyoming and on certain light-duty spurs, including the Coalmont Branch west of Laramie to North Park, Colorado.

MINERAL RESOURCE AND RESERVE BASE ESTIMATES FOR WYOMING

PETROLEUM

Remaining Resources (January 1, 1985)

Discovered (Includes 10 billion barrels recoverable by enhanced recovery techniques)	13.5 billion barrels[1]
Undiscovered	7.6 billion barrels[1]
Total	21.1 billion barrels

Remaining Reserve Base (January 1, 1985)

Measured reserves (Proved reserves)	0.95 billion barrels[2]
Indicated and inferred reserves	2.8 billion barrels[3]
Total	3.75 billion barrels

NATURAL GAS

Remaining Resources (January 1, 1985)

Discovered	19.8 trillion cubic feet[1]
Undiscovered (there is another 35 trillion cubic feet of noncombustible CO_2 gas)	58.0 trillion cubic feet[1]
Total	77.8 trillion cubic feet[1]

Remaining Reserve Base (January 1, 1985)

Measured reserves (Proved reserves)	10.48 trillion cubic feet[2]

COAL

Remaining Resources (January 1, 1985)

Identified (Discovered)	136.4 billion tons[4]
Undiscovered	800.0 billion tons[5]
Total	936.4 billion tons

Remaining Reserve Base (January 1, 1985)

Demonstrated strippable (Measured and indicated reserve base)	27.5 billion tons[4]
Demonstrated underground-minable (Measured and indicated reserve base)	38.4 billion tons[4]
Total	65.9 billion tons

TRONA

Original Resources (1983 estimate)

Trona	81.7 billion tons[6]
Mixed trona and halite	52.7 billion tons[6]
Total	134.4 billion tons

URANIUM

Remaining Resource (January 1, 1983)		995,000 tons[7]
Remaining Reserve Base (January 1, 1983)	ORE	U_3O_8
Ore recoverable at $30 or less/ton	29.4 million tons	39,700 tons[7]
Ore recoverable at $30.01-$50.00/ton	225.1 million tons	151,500 tons[7]
Ore recoverable at $50 or less/ton	254.5 million tons	191,200 tons

OIL SHALE

Original Resources (January 1, 1983)

Identified (Discovered)	320 billion barrels of shale oil[8]

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

2 Energy Information Administration, 1985, *U.S. crude oil, natural gas, and natural gas liquids reserves: 1984 Annual Report, October.* (1984 production has been subtracted).

3 Modified from Barlow and Doelger (1983), footnote 1.

4 Wyoming Geological Survey, March, 1985. (Modified from Berryhill, H.L., Jr. and others, 1950, *Coal resources of Wyoming: U.S. Geological Survey Circular 81, 78 p.*

5 *Averitt, Paul, 1975, Coal resources of the United States:* U.S. Geological Survey Bulletin 1412, p. 15.

6 Culbertson, W.C., 1983, *Genesis and distribution of trona deposits in Wyoming* (abstract) in *Genesis and exploration of metallic and nonmetallic mineral and ore deposits of Wyoming and adjacent areas:* Geological Survey of Wyoming Public Information Circular 19, p. 34.

7 U.S. Department of Energy, 1983, *Statistical data of the uranium industry:* Open-file Report GJO-100-(83), 77 p.

8 Knutson, C.F., and Dana, G.F., 1982, *Developments in oil shale in 1981:* American Association of Petroleum Geologists Bulletin, Volume 66, no. 11, p. 2513.

Both the Burlington Northern and the Chicago and North Western Railroads are looking for local sources of ballast. Both railroads are examining quartzite in the Hartville uplift in Platte and Niobrara Counties. The Burlington Northern took a bulk sample of quartzite from the Sunrise area for testing in November.

Reference cited

U.S. Energy Information Administration, 1985, Uranium industry annual, 1984: U.S. Department of Energy Open-File Report DOE/EIA 0478(84), 145 p.

COAL UPDATE

by Richard W. Jones, Coal Geologist, Geological Survey of Wyoming

Based on reported coal deliveries (see table, p.25), it appears that Wyoming's coal production will set another record in 1985. Deliveries through August, 1985, are over 12 million tons ahead of last year's deliveries for the same period. If the current trend continues for the remainder of 1985, the State's production could exceed 145 million tons, somewhat more than we predicted in September of this year (*Wyoming Geo-notes No. 8*, p. 5). Preliminary data from the U.S. Energy Information Administration indicate that Wyoming's cumulative monthly coal production through most of 1985 has been from four to six million tons greater than West Virginia's production. It is possible that by the end of the year, Wyoming may move into second place in coal production in the United States, ahead of West Virginia for the first time.

Additional data on Wyoming's 1984 coal production have recently become available (see table, p. 28). Although production on State and Federal leases increased slightly from 1983 to 1984, the production

REPORTED DELIVERED TONNAGE[1]

	1983 MONTHLY	1983 CUMULATIVE	1984 MONTHLY	1984 CUMULATIVE	1985 MONTHLY	1985 CUMULATIVE
JANUARY	10,313.0	10,313.0	9,540.2	9,540.2	11,601.2	11,601.2
FEBRUARY	8,719.7	19,032.7	9,654.6	19,194.8	10,473.9	22,075.1
MARCH	9,051.2	28,083.9	0,875.0	30,069.8	11,674.9	33,750.0
APRIL	8,195.0	36,278.9	8,721.4	38,791.2	11,632.8	45,382.8
MAY	8,364.6	44,643.5	9,481.5	48,272.7	11,497.9	56,880.7
JUNE	8,330.2	52,973.7	9,464.5	57,737.2	11,692.2	68,572.9
JULY	8,734.7	61,708.4	11,019.6	68,756.8	11,893.5	80,466.4
AUGUST	9,669.3	71,337.7	11,433.0	80,189.8	12,107.1	92,573.5
SEPTEMBER	9,189.7	80,567.4	10,440.0	90,629.8		
OCTOBER	9,406.3	89,973.7	10,492.5	101,122.3		
NOVEMBER	9,013.6	98,987.3	11,814.2	112,936.5		
DECEMBER	7,680.6	106,667.9	11,486.8	124,423.3		
TOTAL	106,667.9		124,423.3			

TOTAL TONNAGE NOT REPORTED[2]

5,520.0	6,322.5

TOTAL TONNAGE PRODUCED[3]

112,187.9	130,745.8

[1] Source: *National Marketing Reports* by Coal Marketronix, compiled from FERC Form 423 filed monthly by electric utilities.

[2] Includes industrial, residential/commercial, and smaller utility sales.

[3] Source: Wyoming State Mine Inspector's Annual Report for 1983 and for 1984.

from privately-owned (fee) coal increased nearly 62 percent over the same period and now accounts for about one-third of the entire State's production. Coal on State leases was valued at about $344 million and accounted for nearly $15 million in royalties for the State. Coal from Federal leases in Wyoming was valued at nearly $846 million with an average value of $12.15/ton; the total value of the coal increased about seven percent over 1983's $787 million, and the average value increased by five percent over 1983's $11.58/ton. Over $23 million in royalties were collected from Federal leases in 1984, an increase of about eight million

Coal production and forecast to 1991 (millions of tons).

	1981[1]	1982[1]	1983[1]	1984[1]	1985	1986	1987	1988	1989	1990	1991
Campbell County	71.6	81.2	88.2	106.8	120.7	122.9	124.4	125.9	127.8	126.6	127.4
Converse County	3.6	3.4	2.7	3.3	3.3	5.0	5.4	6.3	6.3	8.7	8.7
Sheridan County	2.8	3.0	2.9	2.5	2.9	2.0	2.0	1.5	-	-	-
Carbon County	8.5	5.0	4.8	5.1	3.2	2.9	2.4	2.0	1.6	1.1	0.3
Sweetwater County	11.2	11.0	9.5	8.9	11.0	10.7	10.5	10.8	11.2	10.5	10.5
Lincoln County	5.0	4.3	4.0	4.1	3.9	4.5	4.8	5.0	5.1	5.1	5.1
Hot Springs County	M[2]	M	M	M	M	M	M	M	M	M	M
Total Wyoming	102.8	107.9	112.2	130.7	145.0	148.0	149.5	151.5	152.0	152.0	152.0
Annual change	9%	5%	4%	16.5%	11%	2%	1%	1%	<1%	0%	0%
Estimated contracted production	110.0	119.0	122.6	137.7	145.2	149.2	149.4	151.5	148.6	150.6	151.0
Below contract	7%	9%	8%	5%	<1%	1%	0%	0%	-	-	-

[1] These are actual values for comparison. [2]M means minor tonnage (less than 0.1 million tons). Forecast by Geological Survey of Wyoming, December, 1985.

dollars over 1983's $15 million. This increase is primarily due to readjustments of Federal leases from a system based on the weight of the coal to a system based on the value of the coal produced as well as an increase in production on newer Federal coal leases that already require royalties be paid on the value of the coal. The State of Wyoming is entitled to 50 percent of the royalties from Federal coal leases located in the State. Wyoming accounted for about 66 percent of the 104.2 million tons of Federal coal produced in the United States in Fiscal Year 1984 (U.S. Department of the Interior, 1985).

Data on the production and consumption of energy in the Nation and in each state also became available recently. Wyoming ranked second (behind Alaska) in total per capita energy use in 1983: each person in the State accounted for the consumption of 728 million Btu's (U.S. Energy Information Administration, 1985a). About 59 percent of this total was used for industrial purposes (ranking Wyoming third), 21 percent was used for transportation (ranking Wyoming second), and nine percent was used for commercial purposes (ranking Wyoming third). A total of 573 trillion Btu's of energy were consumed in the State in 1983, with 55 percent of the energy being supplied by coal, 28 percent supplied by petroleum, and 15 percent supplied by natural gas.

A total of 293.8 trillion Btu's of energy were produced at electrical generating plants in Wyoming in 1983; about 96 percent of this was produced by coal-fired plants and most of the remainder was produced at hydroelectric plants (U.S. Energy Information Administration, 1985b). Of the total energy produced from electricity in 1983, 198.7 trillion Btu's or 68 percent was used out-of-state, and 95.2 trillion Btu's or 32 percent was consumed in-state. About 59 percent of the electricity consumed in-state was used for industrial purposes, 22 percent went to residences, and 19 percent was used commercially.

COAL PRODUCTION STATISTICS FOR WYOMING BY COAL OWNERSHIP

	1981	1982	1983	1984
FEDERAL[1]	59,576,163 (58%)	63,612,335 (59%)	67,975,848 (61%)	69,610,380 (53%)
STATE[2]	26,485,275 (26%)	19,872,591 (18%)	18,189,147 (16%)	19,166,425 (15%)
PRIVATE[3]	16,721,996 (16%)	24,469,657 (23%)	26,022,908 (23%)	42,035,878 (32%)
TOTAL[4]	102,783,434	107,954,583	112,187,903	130,812,683

PRODUCTION ON STATE LEASES BY COUNTY[2]

	1980	1981	1982	1983	1984
CAMPBELL	21,417,481	26,274,778	19,015,683	17,297,232	17,968,567
CARBON	160,584	186,430	384,578	353,974	121,175
CONVERSE	-	17,953	472,330	537,941	889,710
LINCOLN	14,107	6,114	-	-	-
SWEETWATER	-	-	-	-	186,973
TOTAL	21,592,172	26,485,275	19,872,591	18,189,147	19,166,425

Reference sources

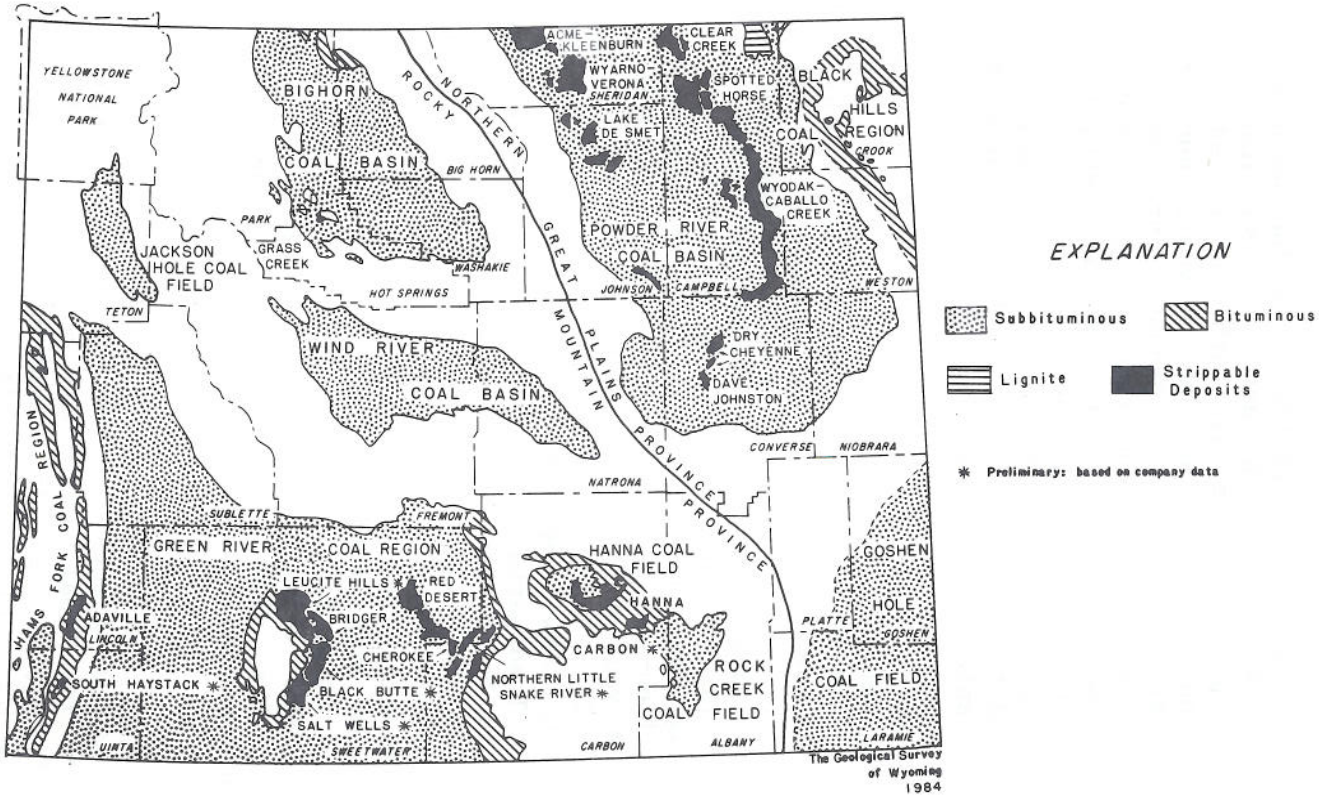
[1] Minerals Management Service Annual Reports: Royalties, 1981; Mineral Revenues, 1982- and 1984

[2] Wyoming Department of Public Lands Annual Reports

[3] Derived from subtraction of Federal and State production

[4] Annual Reports, Wyoming State Mine Inspector and Wyoming Ad Valorem Tax Division

In other news concerning electric utilities, a recent survey by the Atomic Industrial Forum has shown that electricity generated from coal is now cheaper than electricity generated from nuclear energy. In 1984, a kilowatt-hour of electricity cost 4.1 cents when produced from nuclear energy, 3.4 cents from coal, and 7.3 cents from oil. In 1983, a kilowatt-hour cost 3.5 cents to produce from either coal or nuclear energy. For comparison, in 1982, nuclear energy-produced power was 3.1 cents and coal-produced power was 3.2 cents. Although many factors have led to the increased costs associated with producing electricity from nuclear energy, most would agree that cost over-runs, delays, the economy, and increased regulatory



COAL- BEARING REGIONS OF WYOMING

requirements have all contributed. On the other hand, the over supply of coal and the associated bargain-basement prices for it have both contributed to coal's present position. In the next ten years, nuclear power plants are projected to account for much of the increased electrical generating capacity needed to meet growing power demand. If the cost differential between nuclear energy and energy generated from coal continues to increase, it is possible that even more nuclear power plants will be canceled or delayed and that coal-fired plants will be substituted for them.

In coal transportation, the competition for coal hauling contracts between Burlington Northern (BN) and Chicago and Northwestern Transportation Company (C&NW) in the Powder River Basin continues to have its effects. Cordero Mining Company recently completed a private 1.5-mile rail spur, linking the Cordero Mine to tracks jointly operated by BN and C&NW, and began shipping coal over the spur in late August. The 3.3-million-ton per year coal shipments, which began about a year ahead of schedule, are destined for San Antonio City Public Service via coal hauling contracts with the C&NW, the Union Pacific, and the Southern Pacific Transportation Company. City Public Service plans to build two additional 550-megawatt coal-fired units in 1993 and 1995, respectively. These plants will require about 3 million tons of subbituminous coal or 4 million tons of lignite per year. Prior to its contracts with C&NW, the utility had only considered fueling these two units with Texas lignite. But now with C&NW transportation rates reportedly $8/ton cheaper than older rates with the BN, the utility is again considering Powder River Basin coal for the units.

Another effect of the competition for coal transportation contracts is that Burlington Northern is hauling less coal, which has slowed or stopped BN's annual growth rate. In a September 30, 1985, article (McGraw-Hill, Inc., 1985), it was estimated that new contracts that BN lost to C&NW were worth from $250 to $300 million in revenues and that BN's earnings in 1985

would drop about $150 million. To compensate for loss of revenues and to become more price competitive, BN has downsized some of its operations, decentralized several offices to emphasize sales to utility buyers, and improved operational efficiency of its unit train runs. BN has estimated that 4,500 of their employees will lose or have already lost their jobs because of the contracts that have been lost. This number includes 56 BN employees based in Gillette that have been laid off since July, 1985. BN estimates that an average of 229 employees are required to move one million tons of coal. Because of streamlined unit train operations, BN has hauled the same amount of coal (about 68 million tons) in the first half of 1985 as it did during the first half of 1984, but with 20 percent fewer train sets and 200 fewer locomotives.

As part of an effort to increase efficiency of unit train runs, BN has also begun to use "super unit trains" between Gillette and Lincoln, Nebraska. These special unit trains have twice as many coal cars as the normal 100-car trains and are about 12,800 feet long (over two miles). The trains can reportedly carry about 30,000 tons of coal and are powered by six diesel locomotives, three in front and three in the middle. The center locomotives are linked to the front locomotives by a radio system that controls acceleration, tracking, and driving functions. BN is experimenting with a unit train tracking and dispatching system that uses a Navstar Satellite.

Although no new coal purchasing contracts have been announced in the last few months, electric utility companies have been soliciting bids for three long-term contracts and at least four short-term (or spot market) contracts. Meanwhile, Nerco Coal reportedly began production of their newly-constructed Antelope Mine in northern Converse County sometime in November of 1985. This mine becomes Converse County's second active coal mine. Glenrock Coal Company's Dave Johnston Mine, located north of Glenrock, has been the county's only coal mine for a number of years. The Antelope Mine will produce 2.5 to 3.0 million tons of coal per year

and has major contracts with Platte River Power Authority's Rawhide No. 1 power plant near Fort Collins, Colorado, and with Systems Fuels, Inc., a fuel buyer for Middle South Utilities, which supplies coal to power plants located in Louisiana.

The long legal battle between Carbon County Coal Company, the operator of Wyoming's only major underground mine, and Northern Indiana Public Service Company (NIPSCO) is now nearing settlement. Early this fall, Carbon County was awarded $181 million in damages by a U.S. District Court in Indiana for the 15 years that remained on Carbon County's 22-year coal contract with NIPSCO. The court ruled that the 1.5-million-ton per year contract was invalid, thereby enabling NIPSCO to cancel any further deliveries from Carbon County. As a result, Carbon County Coal Company suspended mining operations in mid-October and is currently seeking buyers for 115,000 tons of coal stockpiled at the mine. As of the end of November, no employees at Carbon County had been discharged but with mining suspended, the 283 people employed at the mine may be facing a layoff. The coal company did sell 20,000 tons of its stockpiled coal to Illinois Power Company on the spot market in late November.

In Federal coal leasing activity during the past quarter the U.S. Department of the Interior released a Supplement to their Draft Environmental Impact Statement on the Federal Coal Management Program and reoffered an emergency bypass coal lease tract in an October 16, 1985, coal lease sale. The tract had been offered earlier in July, 1985, but the sole bid from Medicine Bow Coal Company was rejected because the bid did not meet Interior's calculated fair market value. In the reoffering, Medicine Bow increased its previous bid of $187.51 per acre to $481.29 per acre and again was the sole bidder. The U.S. Bureau of Land Management accepted the new bid and following a review by the Justice Department, expects to issue the lease.

A U.S. District Court upheld a suit brought by Whitney Benefits and Peter Kiewit Sons, Company and ordered the U.S. Department of the Interior to exchange other Federal coal for Whitney Benefits holdings in Sheridan County. Earlier, Interior had determined that the Whitney tract did not qualify for exchange because it has a "negative value". At stake is an estimated $8 million coal reserve. The court ordered the exchange be completed by January 30, 1986.

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McGraw-Hill, Inc., 1985, BN watches sales line flatten, while vowing fresh competition: Coal Week, v. 11, no. 3, p. 1 and p. 6.

U.S. Energy Information Administration, 1985a, State energy overview, 1983: U.S. Department of Energy Report DOE/EIA-0354(83), p. 429-436.

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WYOMING SULFUR

by Ray E. Harris, Uranium and Industrial Minerals Geologist

Sulfur, an often unheralded mineral commodity produced in Wyoming, is experiencing a growth in demand, partially in response to an increasing National consumption rate. Although 56 percent of the Nation's elemental sulfur is still produced in Texas and Louisiana, Wyoming produces significant amounts of sulfur as a by-product of sour gas-processing plants.

WYOMING SULFUR PRODUCERS

Name	Location	Capacity in short tons/day
Amoco Production Company	Fremont County	67
Amoco Production Company	Park County	84
Amoco Production Company	Uinta County*	1,309
Chevron USA, Inc.	Uinta County*	985
Colorado Interstate Gas Company	Sweetwater County	97.3
Husky Oil Company	Laramie County	55.2
Sinclair Oil Company	Carbon County	27.6
TOTAL		2,625.1

* Under construction or no current production.

Source: Oil and Gas Journal, September 10, 1984.

Sulfur has also been mined in Wyoming in the past and exploration is being conducted on one deposit near Thermopolis. This and other natural sulfur occurrences may increase in mining potential as demand for sulfur increases.

According to the U.S. Bureau of Mines, Wyoming currently produces 1,892 short tons of sulfur per day, all of which comes from the desulfurization of sour natural gas (gas containing hydrogen sulfide). This daily production equated to about 690.6 thousand short tons of sulfur in 1984 at a value of almost $50 million. Some of this production is sold to the phosphate plant at Leefe, which is operated by Stauffer Chemical Company. The sulfur from Chevron, Inc.'s Carter Creek natural gas processing plant will be used in Chevron's phosphate fertilizer plant under construction southeast of Rock Springs.

Wyoming's natural gas plants have a design capacity of 2,625 short tons per day of elemental sulfur. Nine hundred eighty-five short tons of this capacity come from Chevron's Carter Creek Plant. The largest capacity plant is Amoco's Uinta County natural gas plant - 1,309 short tons per day. The remaining capacity is from Amoco's plants, south of Riverton, and south of

Cody, the Colorado Interstate Gas Company's plant at Rock Springs, the Husky Oil Company's plant at Cheyenne, and the Sinclair Oil Company's Sinclair Refinery.

In addition to these by-product sulfur sources, natural sulfur deposits are found in northwestern Wyoming. These formed from hot spring systems. Sulfur-bearing hot water deposited native sulfur or pyrite in open spaces and replacement bodies as the water cooled. Large deposits are found along the western margin of Star Valley near Auburn, along the Shoshone River immediately west of Cody, and on Cedar Ridge three miles west of Thermopolis.

The Thermopolis deposits occur as sulfur pods and irregular lenses, several inches to over 100 feet in length. These lenses are replacement masses in limestones of the Dinwoody (Triassic) and Phosphoria (Permian) Formations. A small amount of sulfur was produced from this property before 1923. Reserves are estimated to be large (Majors, 1946).

Since the sulfur occurs in a phosphatic limestone, it is possible to mine the sulfur and phosphatic lime together to produce a ready-mixed fertilizer. Recent inquiries regarding this property and shipping costs for the material indicate that this area may be reopened to mining in the future.

These and other natural sulfur occurrences in Wyoming may increase in mining potential as demand for sulfur increases.

Elemental sulfur is generally converted to sulfuric acid before its use. Sulfur is used for fertilizer (65 percent), chemical products used by various industries (10 percent), petroleum refining (7 percent), and metal mining and milling processes (3 percent). The remaining 15 percent is used in a wide variety of industrial products, including rubber and plastic products (Morse, 1985).

The 1984 consumption of sulfur in the United States was 12,400,000 tons. Imports account for about 20 percent of consumption. Most of the imported sulfur comes from Canada (64 percent) and Mexico (36 percent) (Morse, 1985). In the third quarter of 1985, sulfur consumption in the United States was increasing at a rate of about 10 percent per year (U.S. Bureau of Mines data), which is somewhat below the 20 percent per year increases reported in 1983 and 1984.

The price of sulfur increased from $130.41 per ton in 1983 to about $180.00 per ton in 1984 (Morse, 1985) and may increase about $20.00 per ton in 1985.

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Majors, F.H., 1946, Exploration of the Brutch sulfur deposits, Hot Springs County, Wyoming: U.S. Bureau of Mines Report of Investigations 3964, 19 p.

Morse, D.E., 1985, Sulfur: U.S. Bureau of Mines Mineral Commodity Summaries, 1985, p. 152-153.

U.S. Bureau of Mines, 1983-1985, Sulfur production data: Annual and monthly reports.

GEOLOGY FIELD CAMPS IN WYOMING

by Rodney H. DeBruin, Stratigrapher, Geological Survey of Wyoming

Based on a recent survey conducted for the Geological Survey of Wyoming the following Geology Field Camps reported that they conduct work in Wyoming (see also the map on p. 41).

Name and address of field station:	Ball State University Field Station Northwest Community College Powell, Wyoming 82435
Professor in charge of field course:	Dr. Harlan H. Roepke
Location of field study area in Wyoming:	Elk Basin and northwest Wyoming
Name and address of university:	Department of Geology Ball State University Muncie, Indiana 47306

Name and address of field station:	Black Hills Field Camp Beulah, Wyoming 82712
Professor in charge of field course:	Dr. James Martin (South Dakota School of Mines and Technology)
Location of field study area in Wyoming:	Black Hills
Names and addresses of participating universities:	Department of Geology and Biology Bemidji State College Bemidji, Minnesota 56601 Department of Geology Gustavus Adolphus College St. Peter, Minnesota Department of Geology and Geological Engineering South Dakota School of Mines and Technology Rapid City, South Dakota 57701 Division of Science and Mathematics University of Minnesota-Morris Morris, Minnesota 56267 Department of Plant and Earth Science University of Wisconsin-River Falls River Falls, Wisconsin 54002

Name and address of field station:	Idaho State University Geology Field Camp % Alpine 4-H Alpine, Wyoming 83128
Professor in charge of field course:	Dr. H. Thomas Ore
Location of field study area in Wyoming:	Northwest Wyoming including Yellowstone National Park and the Overthrust Belt
Name and address of university:	Department of Geology Idaho State University Pocatello, Idaho 83209

Name and address of field station:	Iowa State University Geology Field Station Shell, Wyoming 82441
Professor in charge of field course:	Dr. Carl F. Vondra
Location of field study area in Wyoming:	Bighorn Basin
Name and address of university:	Department of Earth Sciences Iowa State University Ames, Iowa 50010

Names and address of field station:	Sierra Madre Ranch P.O. Box 1309 Saratoga, Wyoming
Professor in charge of field course:	Dr. William B. Travers (Cornell)
Location of field study area in Wyoming:	Sierra Madre Medicine Bow Mountains, Como Bluff area, Sinks Canyon, and Overthrust Belt west of Pinedale
Names and address of participating universities:	Department of Geological Sciences Cornell University Ithaca, New York 14853 Department of Geological Sciences Harvard University 24 Oxford Street Cambridge, Massachusetts 02138 Department of Geology and Geophysics Yale University New Haven, Connecticut 06511

Names and address of field station:	Timberline Ranch P.O. Box 308 Dubois, Wyoming 82513
Professor in charge of field course:	Dr. Robert G. McWilliams
Location of field study area in Wyoming:	Northwest Wind River Basin, Fremont County
Name and address of university:	Department of Geology Miami University Oxford, Ohio 45046

Names and address of field station:	University of Akron Geology Camp Casper College Casper, Wyoming
Professor in charge of field course:	Dr. Arthur E. Burford
Location of field study area in Wyoming:	Casper area, Emigrant Gap anticline, Casper Mountain, and Hat Six area
Name and address of university:	Department of Geology University of Akron Akron, Ohio 44325

Name and address of field station:	University of Illinois Summer Geology Field Camp Sheridan College Sheridan, Wyoming 82801
Professor in charge of field course:	Dr. Ralph L. Langenheim, Jr.
Location of field study area in Wyoming:	Northeast flank of Bighorn Mountains from Story to the Montana line
Name and address of university:	Department of Geology University of Illinois-Urbana Urbana, Illinois 61801

Name and address of field station:	University of Missouri Field Station P.O. Box 590 Lander, Wyoming 82520
Professor in charge of field course:	Dr. George Viele
Location of field study area in Wyoming:	Derby Dome, Dallas Dome, and South Pass area
Name and address of university:	Department of Geology University of Missouri-Columbia Columbia, Missouri 65211

Names and address of field station:	University of Southwestern Louisiana Field Station Northwest Community College Powell, Wyoming 82435
Professor in charge of field course:	Dr. Richard U. Birdseye
Location of field study area in Wyoming:	Bighorn Basin
Names and address of university:	Department of Geology University of Southwestern Louisiana Lafayette, Louisiana 70504

Names and address of field station:	University of Wisconsin-Milwaukee Field Station Lovell, Wyoming 53201
Professor in charge of field course:	Dr. Richard A. Paull
Location of field study area in Wyoming:	Sheep Mountain area southeast of Lovell
Name and address of university:	Department of Geological Sciences University of Wisconsin-Milwaukee Milwaukee, Wisconsin 53201

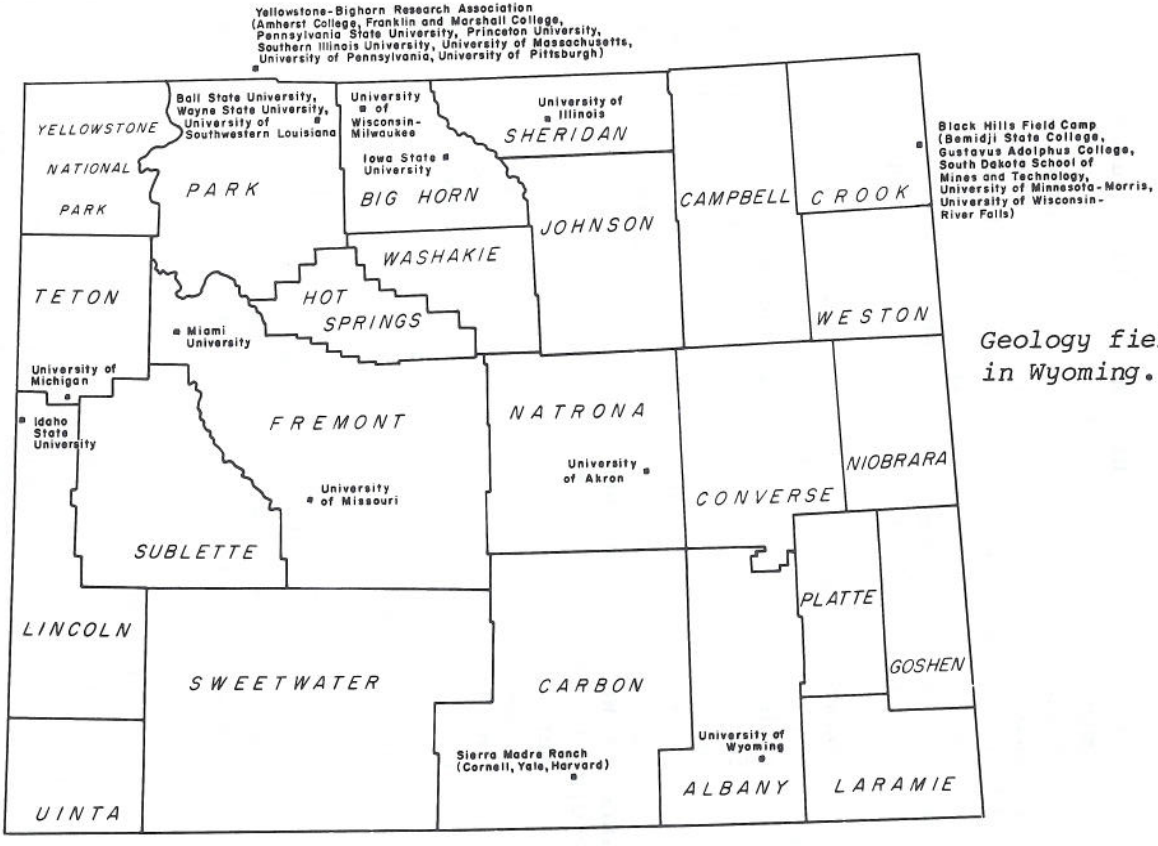
Name and address of field station:	University of Wyoming Geology Field Station P.O. Box 3006, University Station Laramie, Wyoming 82071
Professor in charge of field station:	Dr. Robert S. Houston
Location of field study area in Wyoming:	Centennial Valley, Wagonhound area, and Ring Mountain area
Name and address of university:	Department of Geology and Geophysics University of Wyoming Box 3006, University Station Laramie, Wyoming 82071

Although the Yellowstone-Bighorn Research Association is located in Montana, it is included here since it is only five miles north of the Wyoming border and many of its field study areas are in Wyoming.

Name and address of field station:	Yellowstone-Bighorn Research Association Box 638 Red Lodge, Montana 59068
Professor in charge of field course:	Dr. Richard M. Foose of Amherst College is the President of the Association. This is a rotating presidency. The various members provide professors.
Location of field study area in Wyoming:	Bighorn Basin, Bighorn Mountains, Owl Creek Mountains, Beartooth Mountains, Absaroka Range, Rattlesnake Mountain, and Yellowstone National Park

Names and addresses of participating universities:	Department of Geology Amherst College Amherst, Massachusetts 01002 Department of Geology Franklin and Marshall College P.O. Box 3003 Lancaster, Pennsylvania 17604 Department of Geosciences Pennsylvania State University - University Park University Park, Pennsylvania 16802 Department of Geological and Geophysical Sciences Princeton University Princeton, New Jersey 08544 Department of Geology Southern Illinois University-Carbondale Carbondale, Illinois 62901 Department of Geology and Geography University of Massachusetts Amherst, Massachusetts 01003 Department of Geology University of Pennsylvania Philadelphia, Pennsylvania 19104 Department of Geology and Planetary Science University of Pittsburgh Pittsburgh, Pennsylvania 15260

In addition to the camps listed above, Dartmouth College spends part of their field course in the Bighorn Basin. The Professor is Dr. Gary D. Johnson. Memphis State University visits the Buffalo and Crazy Woman Canyon area as part of their field course. Dr. David B. Bieler is in charge. SUNY at Stony Brook is currently mapping the anorthosite body in the Laramie Range. This project is under the direction of Dr. Donald H. Lindsley.



Geology field camps in Wyoming.

PACIFIC POWER AND LIGHT'S POWER POLE NUMBERING SYSTEM - A WAY OF LOCATING YOURSELF IN THE FIELD

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

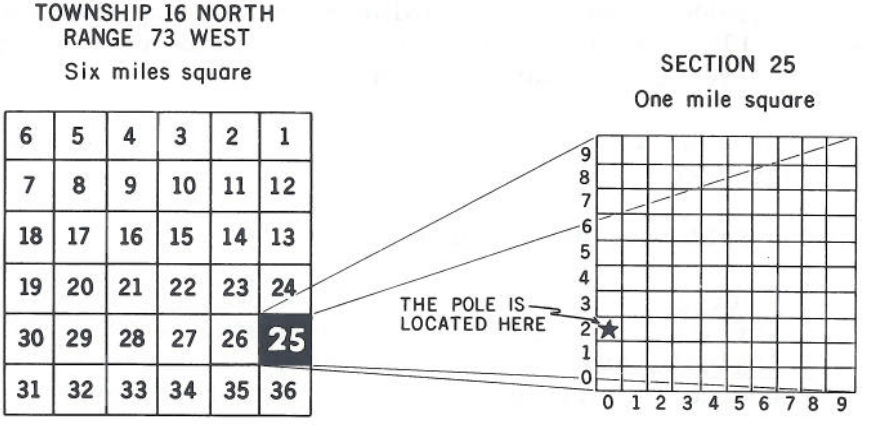
Pacific Power and Light Company (PP&L) uses a power pole numbering system based on the U.S. Public Land Survey Township and Range System. Consequently, PP&L's power poles provide a method of locating oneself in the field on a foggy day, in timber, or on the open prairie when other sighting methods fail. Although not as precise as other methods, the system locates power poles within a square 0.1 mile (528 feet) on a side.

The numbering system is found on the yellow, metal, license plate-like tags found on the power poles (see photograph below). In the illustrated example, the upper four numbers, 16-73 (sometimes given as four consecutive numbers: 1673) refer to the township and range of the Public Land Survey. Therefore, the pole in the illustration is located in Township 16 North, Range 73 West of the 6th Principal Meridian. All of Wyoming is north of the base line and west of the principal meridian, with the exception of the Wind River Indian Reservation, which has its own principal meridian and base line. In that area, you must know whether you are north or south of the base line and east or west of the Wind River Meridian since these directions are not given on the tag.

Returning to the illustrated example, the first two numbers (25) of the 6-digit lower row give the section number within the township. Therefore, this pole is located within section 25, of Township 16 North, Range 73 West.

The next two numbers (02) locate the pole within the PP&L grid within the section. This grid is illustrated below. The numbers originate in the southwest corner, beginning with zero and increasing to nine to the north and east. In the example, the pole is located in column 0 east, row 2 north. With these numbers, the

An example of Pacific and Light Company's power pole tags.



Locating yourself using the Pacific Power and Light Company's power pole tag numbering system (The example is the illustrated tag in this article).

pole is located within a 528 feet x 528 feet square. If you have the Laramie 7½-minute topographic quadrangle map, you could find the pole location fairly precisely.

The final two numbers (01) refer to the pole number within the grid. This is pole number one. If there were more than one pole, the next would be number 02, 03, etc.

Sources: Oregon Geology, v. 41, no. 8, August 1979, p. 134-135. Pacific Power and Light Company, 920 SW 6th Street, Portland, Oregon 97204

FOSSIL COLLECTOR'S ADVISORY

Did you know that you can be cited, taken before a U.S. Magistrate, and fined for picking up fossils on the National Forests? You can, and so can any recreational fossil collector. It has happened.

All of the University students and faculty attending summer camps in the public land States in the West and all of the petroleum geologists, paleontologists, and stratigraphers have been violating Federal Regulations since 1981 if they did not have valid permits to collect fossils on National Forest lands.

If you need a reference, check 36 CFR 261.9 (g) and (h) which states:

The following are prohibited:

(g) Digging in, excavating, disturbing, injuring, destroying, or in any way damaging any paleontological, prehistoric, historic, or archaeological resource, structure, site, artifact or property.

(h) Removing any paleontological, prehistoric, or archaeological resource, structure, site, artifact or property.

[46 FR 33520, June 30, 1981]

A check with the Medicine Bow National Forest office in Laramie, Wyoming, determined that there is a permitting procedure for bonafide fossil collecting on National Forest lands. The Forest Service requires a collector to have a Special Use Permit for collecting fossils. The details of how you get the permit etc. seem to be delegated to the individual National Forests.

If you did not know already, there are also fossil-collecting regulations applying to the U.S. Bureau of Land Management lands as well as many State-owned lands in the West. In the latter case, Fossil Collecting Permits are definitely required in Wyoming, Utah, and New Mexico.

If you think these rules and regulations may be of interest, contact the U.S. Forest Service before you try to collect fossils on their lands; State Offices of the U.S. Bureau of Land Management can provide information on their lands. In the case of individual States, a good contact would be the State Geological Surveys. Although the State Geological Surveys may not be the regulatory or permitting entity, they should be able to advise you on rules and regulations in their States. Fossil collecting on Wyoming's State-owned lands, incidentally, are regulated by the Department of Public Lands. There is also an informal group called IMPACT, which is chaired by Jim Madsen, State Paleontologist of Utah, which is tracking such regulations. Jim can be reached at the Utah State Historical Society, 300 Rio Grande, Salt Lake City, Utah 84101-1182 (phone [801] 533-5755).

RECENT AND NEW PUBLICATIONS BY THE GEOLOGICAL SURVEY OF WYOMING

Bibliography of graduate theses and dissertations on the geology of Wyoming, 1899 through early 1984 (exclusive of the University of Wyoming) compiled by G.B. Glass, Public Information Circular PIC-24, 1985 ($5.00).

Metallic and industrial minerals map of Wyoming, compiled by R.E. Harris, W.D. Hausel, and J.E. Meyer, Map Series MS-14, 1:500,000 scale, color, 1985 ($10.00).

Geologic map of Wyoming, compiled by J.D. Love and A.C. Christiansen, 1:500,000 scale, color, 1985 ($7.30) ($10.50 mailed). Published by U.S. Geological Survey.

Complete list of publications by the Geological Survey of Wyoming from its beginnings in the Territorial Period (1877-1890) to the present, compiled by G.B. Glass, Information Circular, 1985 (free).

Tectonic map of the Bighorn Basin, Wyoming, showing oil and gas development through May 1985, compiled by A.J. VerPloeg, Open File Report 85-11, 1:250,000 scale, 1985 ($4.00).

* *Geologic map showing the present configuration of the Heart Mountain fault and related features, Wyoming and Montana*, by W.G. Pierce, Map Series MS-15, 1:125,000 scale, color, 1985 ($4.00).

* *Oil and gas potential of the Washakie (South Absaroka) Wilderness and adjacent roadless areas, Wyoming*, by J.D. Love, Report of Investigation 33, 1985, ($3.00).

* *Preliminary report and map on potentially seleniferous areas in Wyoming*, by J.C. Case and C.S. Boyd, 1985 ($3.50).

* *Fifty-second annual report of the Geological Survey of Wyoming for fiscal year 1985, July 1, 1984, to June 30, 1985*, by G.B. Glass, 1985 (free).

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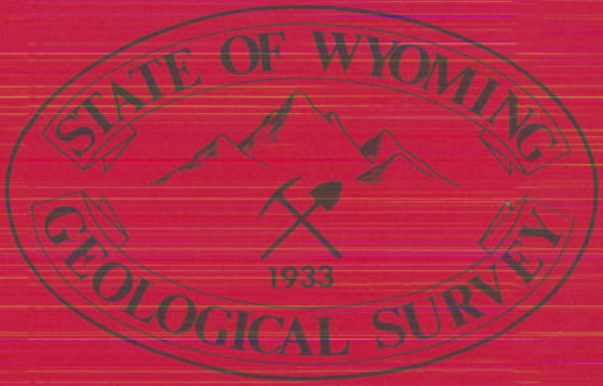
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