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

WYOMING GEO-NOTES NO. 3

Laramie, Wyoming
June, 1984

WYOMING GEO-NOTES

Published for free distribution by

The Geological Survey of Wyoming
P.O. Box 3008, University Station
Laramie, Wyoming 82071

Wyoming GEO-NOTES was first published in July, 1977, as a semi-annual 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 will now form the backbone for a rejuvenated Wyoming Geo-Notes. The Newsletter will be published quarterly and expanded to include Staff and Survey activities and projects.

OVERVIEW

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

The news is still good in the second quarter of 1984. Highlighting cautious optimism for the remainder of 1984 are the year-end oil and gas production statistics for 1983. The Wyoming Oil and Gas Conservation Commission reported gross production of oil was 120,979,721 barrels or 2.4 percent more than 1982. What is more important, this increase has reversed the steady 2-3 percent production decline that has characterized Wyoming's oil production since 1978. Increased oil production is forecast again in this the Centennial year of the oil and gas industry. On the other hand, Wyoming's average wellhead oil price in 1983 (estimated at $27.20/barrel) was about $1.00/barrel lower than 1982. Although most analysts predict that the current escalation of the conflict between Iran and Iraq will not have any major effect on U.S. production or prices, if they are wrong, the demand and price can only increase. Wellhead oil prices in the first month of 1984, however, were down 25 cents per barrel.

Natural gas production in Wyoming increased to 539.8 billion cubic feet in 1983, a 13.8 percent increase over last year. The average price paid for natural gas produced in Wyoming apparently increased about 28 cents per thousand cubic foot to an estimated $3.50. Again natural gas production was limited by market demand rather than supply constraints, and production could increase rapidly if the demand grows.

Other mineral production, except for uranium and of course the now all but defunct iron ore

industry, are tracking or exceeding 1983 levels of production. In the first three months of 1984, for example, Wyoming coal production was two million tons above last year. In 1984, the State's coal production is currently forecast at 118 million tons, an increase of five percent over 1983. Renegotiated contracts, however, continue to indicate a trend to lower prices. The most recently announced price adjustment reduced an FOB mine price over 29 percent (see Coal Update in this issue).

Although there is still no significant production of precious metals in Wyoming, exploration for gold, silver, and other precious metals and diamonds continues across the State (see Metal and Precious Stones Update in this issue).

Recovered sulfur derived from the State's petroleum industry is a seldom mentioned but rapidly growing product from Wyoming's sour gas reservoirs. Two large sour gas plants in the Thrust Belt of westernmost Wyoming are continuing to produce increasing quantities of the element as gas production from that area increases. Only the weak market for natural gas is restricting this production. Other sour gas plants are planned. Although overall U.S. production of sulfur declined in 1983, recovered sulfur from the petroleum industry continues to replace Frasch production of sulfur, and now accounts for 53.3 percent of the total U.S. production.

In 1982, Wyoming's share of the United States' recovered sulfur production was almost 69,000 tons with a value of $3.3 million. This production equated to 14.7 percent of the 4.7 million tons that were produced in that year. U.S. production of recovered sulfur increased to 5.4 million tons in 1983. Although Wyoming's

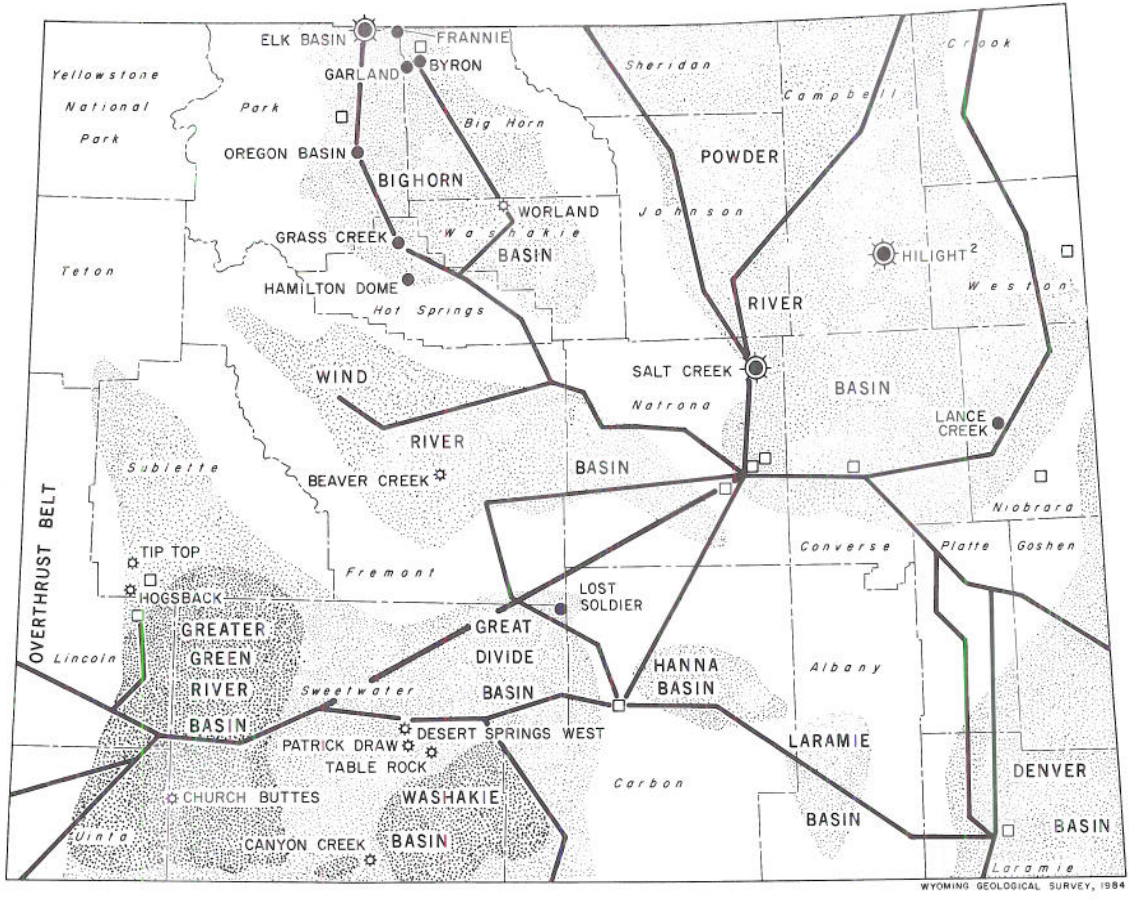
share of this 1983 production is not available at this time, combined production from Amoco's Whitney Canyon plant and Chevron's Carter Creek plant could reach 840,000 tons of sulfur each year. At 1982 prices, this tonnage would be valued at close to $40,000,000. Also, sulfur concrete is emerging as a potentially large, new nonagricultural market for sulfur.

OIL AND GAS

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

Seasonal weather constraints are cited as reasons for the rig count remaining below 100, well into May. By the third week in May, however, the rig count had reached 83 as compared to 59 in May of 1983, and indicated the oil and gas industry is still on the upswing. Activity is expected to increase as weather conditions improve.

The Wyoming Oil and Gas Conservation Commission adopted several amendments to its Seismic Rule No. 339, effective May 1. The new rule, which defines geophysical contractors, seismic contractors, and client companies, also requires a permit before commencing seismic activity in the State. The permit may be revoked for failure to comply with Commission rules thereby prohibiting the seismic contractor from further work. To obtain a permit, representatives of the seismic contractor and the client company must schedule an advance meeting with the Commission staff as well as furnish information pertaining to the project. The new rule also requires a blanket



WYOMING GEOLOGICAL SURVEY, 1984

EXPLANATION

Major Wyoming Basins

Oil shale occurrences

Oil and gas pipeline corridors

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 1981

[2] CUMULATIVE OIL PRODUCTION OF HILIGHT FIELD WAS 70 MILLION BARRELS THROUGH 1981

GENERALIZED OIL AND GAS INDEX MAP OF WYOMING

bond of $50,000, and stipulates that the client company along with the seismic operator may be held responsible for noncompliance with Commission rules.

A new and promising plugging technique for seismic shot holes was tested in April of this year. A discussion is included in the Uranium and Industrial Minerals Update in this issue of Geo-Notes.

Howard Schrinar was recently appointed to the vacant post of Commissioner of Public Lands. As Commissioner of Public Lands, Schrinar is also a member of the Wyoming Oil and Gas Conservation Commission, the State's oil and gas regulatory agency. In a recent interview, Schrinar, a lawyer with oil and mining company experience, said he hopes to initiate a program to better identify what is happening on State lands. He also intends to continue with the oil and gas lease auction system as there were too many opportunities for fraudulent activities in the old lottery system.

In May, the State's fifth oil and gas lease auction generated $1.52 million in revenue from bids on 200 parcels. This compared to $2.31 million in January and $2.17 million in March, and is the smallest total of the five auctions that have been held under the new system. The highest bid in the May auction was Amerex Corporation's $390 per acre bid for a 560 acre parcel in Campbell County, adjacent to the Bone Pile field.

A ruptured pipeline near Evanston, Wyoming, spilled 6,000 barrels of crude oil into Bear River on May 26th. Amoco Pipeline Company, the operator, indicated that high water in Bear River may have caused the break. Cleanup is expected to

take several weeks. Evanston's water supply is 15 miles upstream from the spill, so no contamination of their water source occurred.

Chevron Chemical Company plans to start construction of a $250 million fertilizer plant in the Rock Springs area in June. Peak construction force will be about 1,000 by the summer of 1985. When completed the plant will have an annual capacity of 400,000 tons of ammonium phosphate fertilizer. Phosphate will be transported via a 95-mile slurry pipeline from a Chevron mine near Vernal, Utah. Chevron's Carter Creek gas processing plant in Uinta County, Wyoming, will supply the sulfur.

Gulf Exploration's subthrust test near Story, Wyoming, was completed as a dry hole in March. The well was drilled to a total depth of 15,710 feet at a cost of $10-12 million. Gulf has also appealed a decision of the Wyoming Oil and Gas Conservation Commission which prevented them from constructing their preferred access road to a second drilling site. The outcome of that appeal is pending in court. There is some indication that Gulf may want to continue its exploration of the subthrust structure targeted in the first hole.

Gulf's well, incidentally, was the first test of subthrust structure on the east flank of the Bighorn Mountains, and their well penetrated more than 5,000 feet of granite before reaching underlying sedimentary rocks. More importantly, Gulf's well continues a relatively recent exploration trend to test the oil and gas potential of Wyoming's mountain front thrusts. Reprint No. 37, which is available from the Wyoming Geological Survey, details the history of prospecting beneath the Precambrian foreland thrust plates in the Rocky Mountains.

General Hydrocarbons, Inc. has announced completion of a gas discovery in Park County, Wyoming, 2.5 miles from Heart Mountain field. The well (sec. 4, T.54N., R.102W.) was tested at 2.3 million cubic feet of gas from Lower Cretaceous Muddy Sandstone and 1.6 million cubic feet from Upper Cretaceous Frontier Formation.

Celsius Energy recently completed a high volume gas producer in Butcher Knife Springs field on the southern end of the Moxa Arch in southwestern Wyoming. The well (sec. 1, T.14N., R.113W.) flowed 6.5 million cubic feet of gas and 120 barrels of condensate from Lower Cretaceous Dakota Sandstone.

Exxon may have found a market for carbon dioxide from its proposed Riley Ridge gas processing plant. Chevron is interested in using the CO_2 for enhanced oil recovery operations in Rangely field in northern Colorado. The gas which will be produced from the deep (greater than 14,000 feet) Mississippian Madison Limestone reservoir in the Riley Ridge area contains approximately 70 percent carbon dioxide. Two other companies, Mobil and Shell, are competing with Exxon for the Chevron contract, but it appears Exxon may have the inside track. Estimates of the huge CO_2 reserves in the Riley Ridge Project are 13.4 trillion cubic feet.

WYOMING OIL AND GAS PRODUCTION FORECAST TO 1991[1]

Calendar Year	Natural Gas production (billions of cubic feet)	Oil Production (millions of barrels)
*1980	450.6	126.4
*1981	455.4	122.1
*1982	465.1	118.7
*1983	539.8	121.0
1984	550.0	119.0
1985	560.0	119.0
1986	580.0	118.0
1987	620.0	117.0
1988	660.0	116.0
1989	700.0	114.5
1990	740.0	113.0
1991	780.0	111.5

*These are actual values for comparison.

[1] Forecast by Wyoming Geological Survey, June, 1984.

URANIUM AND INDUSTRIAL MINERALS

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

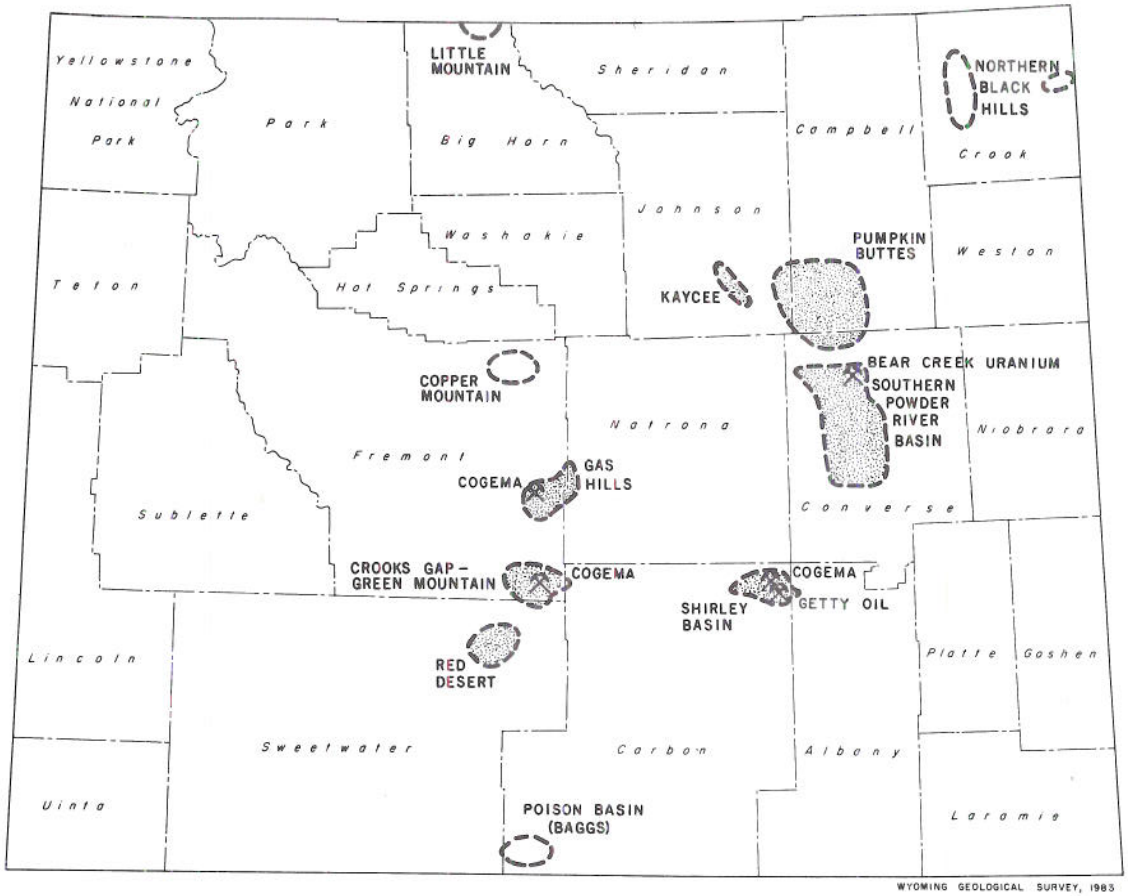
Uranium

Layoffs continue at Wyoming's uranium mines and mills. Pathfinder Mines (COGEMA) laid off 14 employees at its Shirley Basin operations in March. Even though two of the five remaining uranium mines in Wyoming are in the Shirley Basin, the effects of reduced production and associated mine layoffs have also forced the closing of local stores and reduced the number of teachers employed in the towns of Shirley Basin and Medicine Bow.

The spot market price of uranium dropped to $17.00 in April and rebounded to $17.75 in May. This is still less than half of the 1979 price. Essentially no uranium is being purchased domestically on the spot market.

Nevertheless, nuclear power's share of the world's energy production grew from 8 percent to about 10 percent in 1983. Nuclear plants outside of the U.S. continued to produce electricity at lower cost than other methods of electrical generation. France achieved a level of over 50 percent of its electricity produced from nuclear power. In the U.S., nuclear power slightly increased its share of total electricity production to nearly 15 percent.

Continued growth of nuclear power has enabled growth in world uranium production. However, because domestic power producers have large stockpiles of uranium, reduced production from Wyoming and other U.S. mines is foreseen for the near future.



EXPLANATION

Uranium district with active or recent mining

Uranium district without recent mining

Active Uranium mine December, 1983

MAJOR ACTIVE AND INACTIVE URANIUM DISTRICTS

Trona

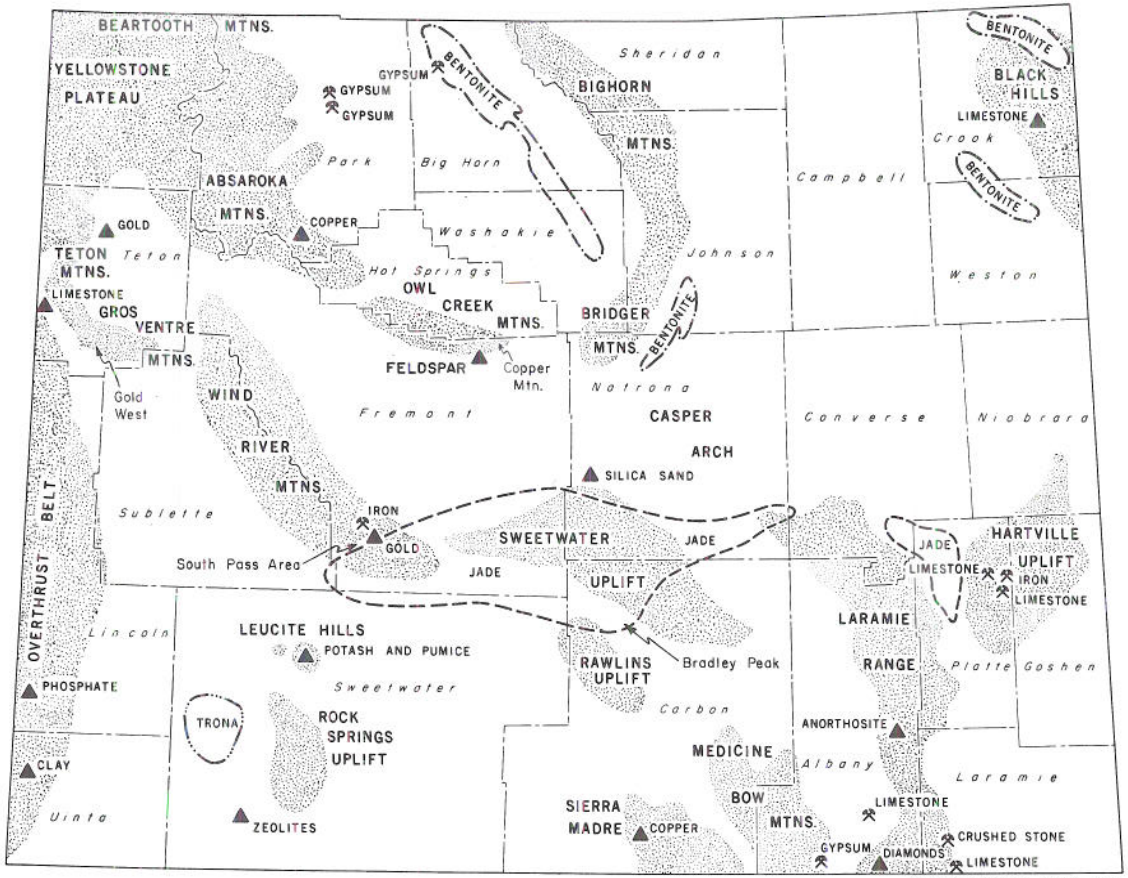
According to figures recently released by the Wyoming State Inspector of Mines, Wyoming's 1983 trona production was 11.6 million tons, a 5.8 percent increase over 1982. Nevertheless, employment in the trona industry decreased by 12.8 percent from the end of 1982 to the end of 1983. The sale price of soda ash (refined trona) also decreased from a high of $92/short ton in 1982 to a low of $69/short ton in 1983.

Increased production is still forecast for the trona industry due to increased exports and domestic uses other than glass for bottles.

Other Industrial Minerals

Bentonite production continues to increase after the disastrous year of 1983 in which production fell to approximately 1.7 million tons or almost one million tons less than 1982. Employment in the bentonite industry also fell about 30 percent in 1983.

A new market for bentonite may also be forthcoming. In April the Wyoming Oil and Gas Conservation Commission with the help of Amoco Production Company, Norpac Exploration, Buckley Powder, An-Dee Drilling, Wyo-Ben Inc., and Conoco Inc., conducted tests using a new seismic hole plugging material. In the tests, a bentonite and rock gravel was placed in many of the holes before they were detonated. In wet holes, this material settled to the bottom of the hole and then expanded into an immobile plug that prevented any material from blowing out of the hole. The material also works in dry holes. Because seismic holes did not blow out on detonation, the record-



SELECTED MINERAL AND ROCK OCCURRENCES

ing data was excellent, and there was no cratering of the holes.

Although the Oil and Gas Conservation Commission has not made the new technique mandatory, further testing and field experience may warrant that action in the future. Presently, a company can use the technique with prior approval of the Commission staff. Unlike the current plugging procedures on wet holes, which require the hole to be filled with a slurry mixture of bentonite and water, this new plugging procedure is done before the holes are shot, eliminating the need for a sometimes difficult task of reentering shot holes. Reclamation of seismic shot holes, using this procedure, is essentially accomplished before the holes are shot.

The bentonite gravel comes as 1/4 - 3/4 inch particles of bentonite and rock and is often nothing more than waste material from bentonite operations. Because the mixture does not need refining or extensive crushing, it offers an inexpensive plugging material that will not only comply with seismic plugging rules, but can be used in winter weather, can reduce blow outs, and can protect ground water by sealing off holes. This plugging material is particularly adaptable to heliportable operations because it can be used in place of regular gravel, and eliminates a second, follow up trip to plug the line.

Test details are available form the Wyoming Oil and Gas Conservation Commission, P.O. Box 2640, Casper, Wyoming, 82602 (phone: (307) 234-7147).

Limestone, gypsum, and sand and gravel production is increasing throughout Wyoming as construction of all types increases seasonally.

COAL

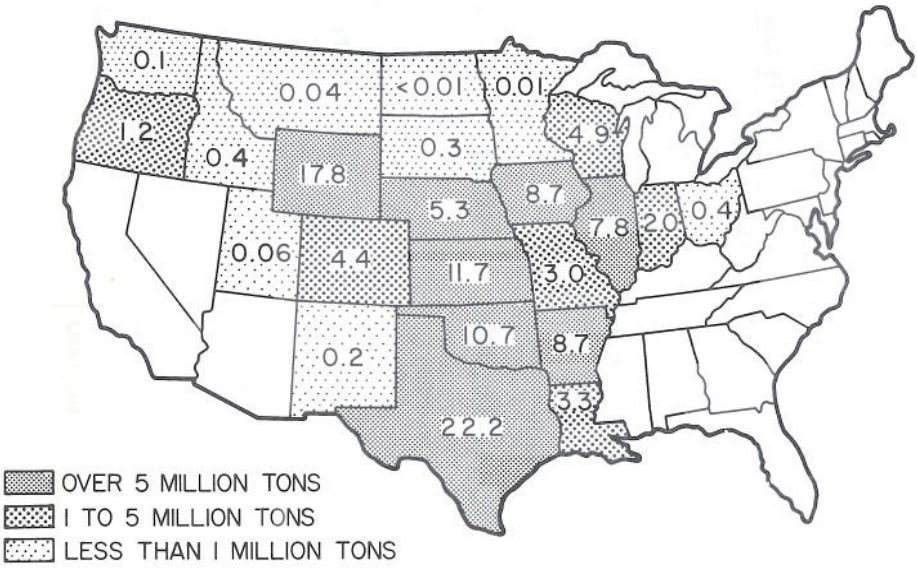
by Richard W. Jones, Coal Geologist, Wyoming Geological Survey

Based on statistics for 1983, Wyoming coal is now used in 23 states. Texas is the largest consumer of Wyoming coal with 22.2 million tons, followed by Wyoming with 17.8 million tons. These two states plus Kansas and Oklahoma used over half the coal produced in Wyoming; nearly 80 percent of the State's coal production went to only seven different states.

Additional information on the usage and transportation of the 112.2 million tons of coal mined in Wyoming in 1983 reveals that over 97 percent of the coal was used by electric utility companies for power generation and that nearly 90 percent of the coal was shipped by rail. Two million tons of Wyoming coal were used in-state by other important mineral-related industries, including the trona, bentonite, and cement industries. Some Wyoming coal was also used to make formcoke. FMC Corporation's formcoke plant in Lincoln County has a patented process for converting noncoking coal to formcoke.

Two major coal supply contracts were recently signed with Powder River Basin mines. Mobil Coal Producing, Inc. completed negotiations with Grand River Dam Authority to supply 0.9 to 1.5 million tons of coal per year from the Caballo Rojo mine. This 20- to 25-year contract will supply the 520-megawatt GRDA No. 2 unit in Oklahoma. The plant, which is designed to burn a mixture of Wyoming and Oklahoma coal, is now under construction with completion set for 1986. Anaconda Minerals Company (Arco), which operates the Black

DISTRIBUTION OF WYOMING COAL, 1983
(IN MILLIONS OF TONS)



NOTE: Total production was 112.2 M.T.; 0.1 M.T. was not reported because individual deliveries were too small to report.

Adapted from McNair, 1984
Wyoming Geological Survey, 1984

DISTRIBUTION OF WYOMING COAL, IN 1983[1]

OUT-OF-STATE

COAL USAGE			TRANSPORTATION		
Usage Category	Percent of Total	Tons	Transportation Type	Percent of Total	Tons
Electric Utilities	98.9	93,249,000	Railroad	96.4	90,923,000
Other Industrial	1.1	998,000	River Barge	3.3	3,065,000
Residential/Commercial	<0.1	59,000	Truck	0.3	305,000
			Other	----	13,000
TOTAL	100.0	94,306,000	TOTAL	100.0	94,306,000

IN-STATE

COAL USAGE			TRANSPORTATION		
Usage Category	Percent of Total	Tons	Transportation Type	Percent of Total	Tons
Electric Utilities	88.0	15,663,000	Railroad	54.5	9,697,000
Other Industrial[2]			Truck	25.5	4,552,000
Trona		1,550,000	Tram/Conveyer	20.0	3,554,000
Formcoke[3]		200,000			
Cement		200,000	TOTAL	100.0	17,803,000
Bentonite		60,000			

Subtotal	11.3	2,010,000
Residential/Commercial	0.7	130,000
TOTAL	100.0	17,803,000

TOTAL IN-STATE AND OUT-OF-STATE

COAL USAGE			TRANSPORTATION		
Usage Category	Percent of Total	Tons	Transportation Type	Percent of Total	Tons
Electric Utilities	97.2	108,912,000	Railroad	89.8	100,620,000
Other Industrial	2.7	3,008,000	Truck	4.3	4,857,000
Residential/Commercial	0.1	189,000	River Barge	2.7	3,065,000
			Tram/Conveyer	3.2	3,554,000
TOTAL	100.0	112,109,000	Other	<0.1	13,000
			TOTAL	100.0	112,109,000

1 From McNair, M.B., 1984, Coal distribution January-December, 1983: DOE/EIA - 0125 (8314Q), 189 p., unless otherwise noted.

2 Wyoming Department of Economic Planning and Development, Minerals Division, 1984, Unpublished data on coal usage in Wyoming.

3 This is the amount of coal used to produce formcoke. Reported formcoke production from Wyoming in 1983 was 100,000 tons.

RESIDENTIAL/COMMERCIAL USAGE OF
WYOMING COAL IN 1983

Private homes	70,950 tons
University of Wyoming	25,000 tons
Warren Air Force Base	15,000 tons
Schools	8,000 tons
State Penitentiary	5,800 tons
Sheridan Veterans Home	5,250 tons
	130,000 tons

Source: Unpublished data, Minerals Division, Wyoming Department of Economic Planning and Development, 1984.

Thunder mine, was selected to supply a 20-year contract for 2.1 to 2.5 million tons of coal per year to Kansas City Power and Light Company's Iatan No. 1 plant in Weston, Missouri.

In other market developments, the Union Pacific and Chicago and Northern Western railroad companies recently signed a transportation contract with Wisconsin Public Service Corporation to carry 0.8 million tons of coal from the Powder

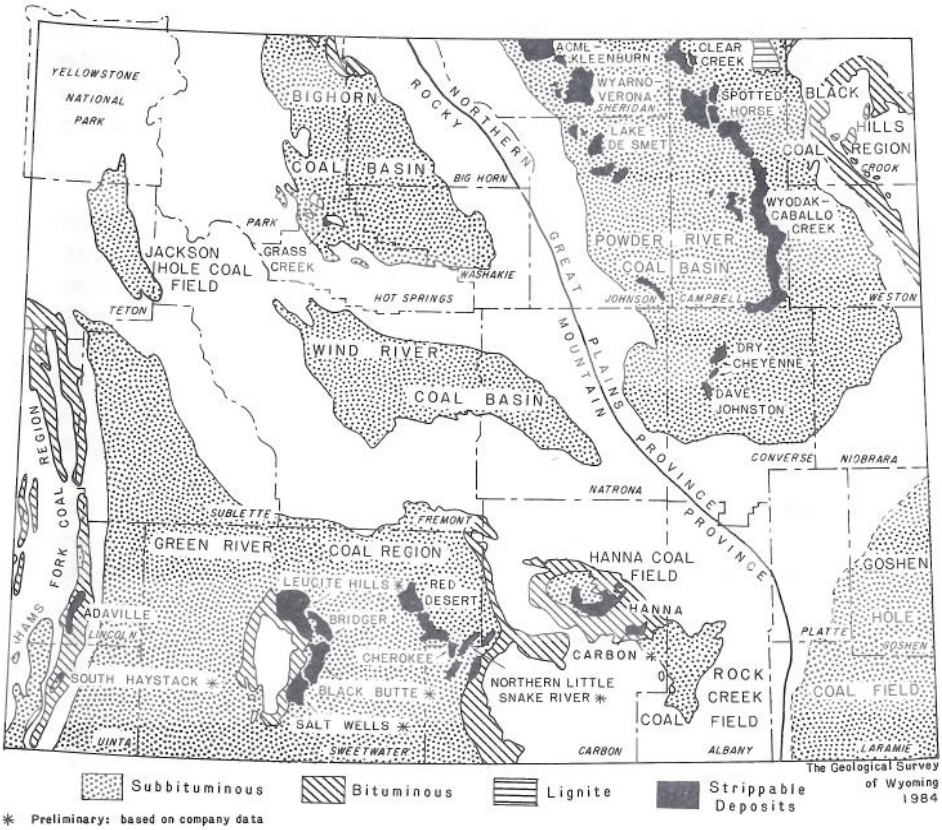
River Basin to Wasau, Illinois. This is the second major transportation contract signed by the two railroad companies, which are currently constructing a new rail line in southeastern Wyoming. The new line will compete with Burlington Northern for coal transportation out of the Powder River Basin. Wisconsin Public Service also renegotiated a contract with Burlington Northern that is expected to lower the utility's transportation costs.

Nebraska Public Power District terminated a 0.2 million ton per year contract with Arch Mineral, which operates a strip mine in the Hanna Basin. Part of the coal under this contract may be replaced by a new contract with Rosebud Coal Sales in the Hanna Basin. Omaha Public Power District has renegotiated a coal supply contract with Exxon (Carter Mining Company's Caballo and Rawhide mines) that resulted in a drop in FOB mine price from $8.25/ton to $5.75/ton. The utility expects to save about $14 million over the next three years by this renegotiation.

Energy Transportation System, Inc. (ETSI), the coal slurry pipeline company, continues to make news. The company recently submitted the low bid for coal transportation from Sunedco's Cordero Mine in the Powder River Basin to San Antonio Public Service Board's Deely Plant in Texas. ETSI's bid, which included 25 megawatts of power generated at the dewatering complex in San Antonio, was less than the two competing railroads' bids and would be ETSI's first confirmed contract. However, the utility has not committed itself to a contract yet, pending an appeal the utility has with the Interstate Commerce Commission against Burlington Northern. If the utility is successful in lowering their current rail rates, they will not complete the

deal with ETSI. The electric utility is also considering other risks with the ETSI project, including the pending litigation for water rights, an incomplete right-of-way, and ETSI's lack of other transportation contracts. At the present time, ETSI is still negotiating with other utilities in Texas for additional long-term contracts. ETSI is also considering extending its pipeline northward into Montana. If successful, ETSI would also slurry Montana coal to its planned market area.

Also affecting ETSI's project are the activities of two of the companies that are partners in the pipeline venture. KN Energy, Inc. is selling half of their 20 percent interest in the pipeline, and Inter-North, a 29.5 percent partner, will decide this summer whether or not to continue their support of the project.



COAL- BEARING REGIONS OF WYOMING

METALS AND PRECIOUS STONES

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

Late spring snows will undoubtedly delay the field activities of many exploration companies this summer. Access to the mountainous areas of the State, in particular, is expected to be several weeks later than other years.

A number of exploration groups and consultants have announced plans to examine the South Pass greenstone belt for gold and tungsten. Some interest has also been expressed in the recently closed U.S. Steel Corporation's Atlantic City iron ore mine. The mine reportedly has ten years worth of iron ore reserves, but was recently closed by U.S. Steel Corporation. The steel producer cited excessive production costs as their reason for the closure. Historically, the South Pass greenstone belt has been Wyoming's most prolific gold and iron ore producer with an estimated 325,000 ounces of gold and more than 90 million tons of iron ore produced from the Archean belt (Hausel, 1980; Hausel and Harris, 1983). All of the iron ore has been produced from iron-formation along the northwestern edge of the belt, and the gold was mined from strike veins and shear zones adjacent to metagabbros, and from related placer deposits.

The Geological Survey of Wyoming is presently reexamining the South Pass greenstone belt. Reconnaissance field work late last fall led to the mapping of three historic underground gold mines (Hausel 1983a, 1983b, 1983c), and the sampling of a gold vein and adjacent wall rock for geochemical and alteration studies (Hausel, 1983d). As time permits this summer and fall, Survey geologists will complete geological maps of

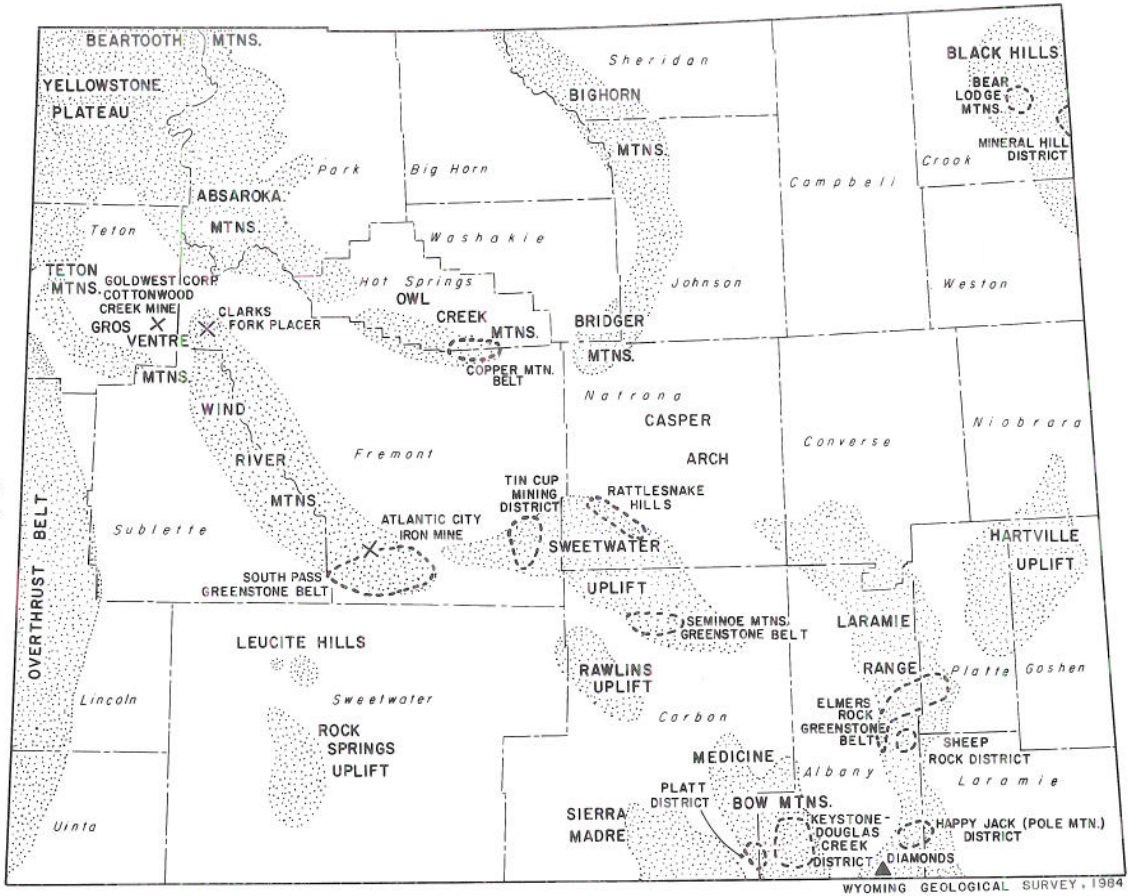
the Lewiston Lakes and Radium Springs 7½-minute quadrangles, and will remap the Louis Lake, South Pass City, Atlantic City, and Miners Delight quadrangles that were mapped by the U.S. Geological Survey in 1973. The goals of the project are to prepare a map of the entire supracrustal belt, to summarize its mineral resources, and to examine the geochemistry of its gold occurrences.

At the present time, a number of small placer operations are producing some gold in the district, and some limited underground activity has been reported at the Carissa and Mary Ellen mines.

Kerr-McGee and Timberline Minerals are exploring the Bradley Peak area of the Seminoe Mountains greenstone belt. Gold was discovered in quartz veins and iron-formation by the Geological Survey of Wyoming in 1981 (Hausel and Harris, 1983). Last year, Timberline Minerals continued drilling on their property at Bradley Peak until deep snows shut down their operations. Timberline is expected to resume drilling as soon as Bradley Peak is accessible.

Some gold activity is anticipated for the historic Tin Cup mining district and in the nearby Rattlesnake Hills of the Granite Mountains near Jeffrey City. Some interesting gold assays have been reported for this region (Hausel and Jones, 1982a).

The Elmers Rock greenstone belt in the central Laramie Range (Graff and others, 1982) has had some recent reports of rich gold placers on Bluegrass Creek. These reports should result in some exploration activity in that region.



REGIONS OF EXPLORATION ACTIVITY FOR STRATEGIC MINERALS

The Copper Mountain supracrustal belt of the Owl Creek Mountains to the north of Shoshoni and four underground mines have been mapped by the Geological Survey of Wyoming. The maps, petrographic and geologic studies, and chemical assays are presently being compiled as an economic geology report. This region will receive exploration activity by mining companies again this summer as it has for many years. Not only does the region have uranium and petroleum potential, but it also has potential for low grade copper, and silver and stratiform gold and tungsten. The accessible workings of the historic De Pass Mine were mapped in 1983, and indications are that the mine was developed into a 50 feet wide mafic dike that carries ore-grade copper with some gold and silver. The extent of the mineralized dike is not known because it disappears to the northeast under Cambrian sediments and was not tested below a depth of 810 feet.

Along strike, the supracrustal belt also contains more than 10 miles of oxide facies iron-formation that in places contains disseminated sulfides. Some adjacent metacherts also contain disseminated sulfides as well as copper oxide, silicate, and carbonate stains that assay in both copper and gold. These relationships and the presence of tungsten-bearing quartzofeldspathic gneisses indicate potential for low grade stratiform occurrences (Hausel and Graff, 1983).

The Hartville Uplift near Guernsey, Wyoming, contains a thick eugeoclinal metasedimentary succession of rocks of Archean age (greater than 2.5 billion years old). During the upcoming field season, companies will search for gold principally in paleoplacers and in stratiform deposits. Some of this activity will probably concentrate on fluvial sandstones and conglomerates of Cambrian(?)

age, and on exhalite deposits (Hausel, 1983e).

Some gold prospecting and exploration is anticipated in the Clarks Fork placer area of the northern Wind river Range; at an undisclosed location in the Bighorn Mountains; in the Bear Lodge and Mineral Hills Districts of the Black Hills; and in the historic Platte District of the Medicine Bow Mountains. Limited paleoplacer gold exploration is also planned for the Late Archean to Early Proterozoic metaconglomerates in the northern Medicine Bow and Sierra Madre Mountains, and in fluvial rock of Cambrian age along flanks of many of the State's mountains.

This summer, gold production is anticipated from Goldwest Corporation's Cottonwood Crook placer mine in Teton County. The proposed operation as planned will process up to 500 cubic yards of alluvial gravel per day using washers and vibrator separators. Life expectancy for the mine is 10 years.

A few hobby and family placer gold operations will probably be working in the Keystone-Douglas Creek District of the Medicine Bow Mountains this summer and fall as they have in past years. Every year, at least several ounces (or more) of gold are mined in this region ranging from dust-size to nuggets up to 1/4- to 1/2-inch in length. A minor amount of platinum is also produced. Two areas in this district that have received some interest recently are the New Rambler Mine and the Keystone-Florence trend. The New Rambler Mine produced rich amounts of copper with associated gold and platinoids. Hausel and Jones (1982b) examined and discussed the possibility of heap leaching some of the mineralized rock.

The Keystone-Florence trend is a northwest

mineralized shear and vein system in the Keystone Quartz Diorite. The Keystone Mine along the western extent of the trend produced an estimated 5,000 to 6,000 ounces of gold and was reported to have 100,000 tons of ore reserves, in place, when mining operations terminated in 1893 (Curry, 1965; Hausel, 1980). The ore reportedly averaged 1.2 ounces of gold per ton (Curry, 1965). The Florence Mine, in the eastern part of the trend, contained some apparently sporadic occurrences of very rich gold ore. Although historic reports are sketchy, mining operations may have terminated because of difficulties associated with mine flooding and ore treatment problems.

Some companies will have exploration activities in the Overthrust Belt of western Wyoming. This region contains red beds mineralized with copper, silver, and zinc (Hausel, 1982) and metalliferous black shales in the Permian Phosphoria Formation. These black shales are of potential interest for disseminated 'noseeum' gold and silver. Interesting amounts of gold, silver, zinc, and vanadium have been reported in these rocks (Harris and Hausel, 1984).

Diamond exploration in the Colorado-Wyoming kimberlite province is continuing. Both Superior Minerals and Cominco American Incorporated are exploring in undisclosed regions.

The Geological Survey of Wyoming is continuing with a stream sediment sampling project in the central and southern Laramie Range. A new district, which contains nearly two dozen anomalous samples, was identified in the Pole Mountain-Happy Jack area. This follows the discovery of the Sheep Rock District in 1980-1981 (Hausel and others, 1981).

The Wyoming Department of Environmental Quality (DEQ) has received federal funding from the U.S. Office of Surface Mining for reclamation of metalliferous mines and associated buildings deemed unsafe by DEQ. The reclamation projects are designed to fill in mine shafts, cave in portal entrances, level and seed mine dumps, and remove hazardous buildings associated with the mine sites. Minimally, the following metalliferous mines are under consideration for the reclamation project:

Copper Mountain District

1. De Pass copper-gold-silver mine (SE1/4SW1/4, SW1/4 SE1/4 sec. 14, T.40N., R.92W.).

2. McGraw copper-iron mine (SW1/4SW1/4SW1/4 sec. 7, T.40N., R.92W.).

3. Comet tungsten mine (N1/2 sec. 22, T.40N., R.93W.).

4. Victory tungsten mine (S1/2 sec. 20, N1/2 sec. 29, T.40N., R.94W.).

5. Gold Nugget mine (SE1/4SE1/4 sec. 11, T.40N., R.94W.).

6. And others.

Lewiston District, South Pass

1. Burr gold-tungsten mine (E1/2NW1/4 sec. 8, T.28N., R.98W.).

2. Hidden Hand gold-tungsten mine (W1/2SE1/4 sec. 5, T.28N., R.98W.).

3. And several others.

Ferris Mountains

1. Babbs copper-tungsten-gold-silver mine (SE1/4SW1/4 SE1/4 sec. 26, T.27N., R.88W.).

Seminoe Mountains District

1. Junk Creek copper-gold mine (SW1/4SW1/4 sec. 20, T.26N., R.85W.).

Keystone-Douglas Creek District

1. New Rambler copper-gold-platinum mine (SW1/4SW1/4 sec. 33, T.15N., R.79W.).

2. Keystone gold mine (SW1/4NW1/4 sec. 22, T.14N., R.79W.).

3. Lake Creek copper-gold mine (NE1/4SE1/4 sec. 2, T.13N., R.79W.).

4. And others.

Grand Encampment District

1. Hercules-Portland copper mines (SW1/4 sec. 29, T.14N., R.85W.).

2. Verde (Hinton) massive copper sulfide mines N1/2NW1/4 sec. 32, T.13N., R.85W.).

3. Broadway zinc-copper-lead Mine (SW1/4 sec. 32, T.13N., R.83W.).

Lake Alice District

1. Griggs copper-silver-zinc mines (N1/2NW1/4 sec. 7, T.28N., R.117W.).

Many of these mines not only represent important historic sites, but additionally provide excellent rock exposures invaluable for explora-

tion and interpretation of geologic history. In an effort to preserve some of this data, the metallic Minerals Section of the Geological Survey of Wyoming intends to map as many of these mines and prospects prior to reclamation as possible. Survey geologists will produce mine maps (scale 1:120), surface maps (1:8,000), and collect a suite of rocks representative of the deposits. The Geological Survey of Wyoming will store the maps and associated geologic reports at their building in Laramie and the State Museum in Cheyenne will keep the rock suites.

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Hausel, W.D., and Jones, Suzanne, 1982a, Field notes - Lost Muffler gold prospect (SW1/4, sec. 16, T.32N., R.87W.), Rattlesnake Hills: Geological Survey of Wyoming unpublished mineral report No. MR82-9, 5 p.

Hausel, W.D., and Jones, Suzanne, 1982b, Geological reconnaissance report of metallic deposits for in situ and heap leaching extraction research possibilities: Geological Survey of Wyoming Open-file Report No. 82-4, 51 p.

NEW OIL AND GAS MAP IN PRESS

The Oil and Gas Section of the Wyoming Geological Survey has completed a 1984 edition of the Oil and Gas Map of Wyoming, which went to the printer in June. The full color, 1:500,000 scale map will be available as Map Series No. 12 (MS-12) sometime in July or early August. Like the earlier 1980 edition of this map, it will show all of Wyoming's oil and gas fields and the producing formations for the fields. Pipelines, refineries, and gas plants are also shown on the map along with major oil shale occurrences.

Sorry, there are no advance copies available. The complexity of a map like this precludes any manner of reproducible work copy. Please watch for our press release before ordering.

STATE SURVEY CONTINUES TAR SAND EFFORTS

Last year, Survey geologists, Alan J. Ver Ploeg and Rodney H. De Bruin, completed a characterization study of the Trapper Canyon tar sand deposit in the eastern Bighorn Basin. The project was partially funded by the U.S. Department of Energy's Laramie Energy Technology Center. Results of this study will be published later this year to include a geologic map of the Bush Butte 7½-minute Quadrangle. This is the second publication stemming from that project. The Wyoming Geological Survey released Open-file Report 82-5: Review of reported tar sand occurrences and recent projects in Wyoming in 1982. This 49 page open-file is available from the Geological Survey for $10.00 plus $2.00 for postage and handling if sent First Class.

This summer, the Oil and Gas Section has initiated a field reconnaissance of known tar sand and heavy oil occurrences in Wyoming. The objectives of this study are (1) to visit and sample the occurrences of tar sands and heavy oils listed in the Geological Survey of Wyoming Open-file Report 82-5 in order to provide a more accurate characterization of each surface occurrence, i.e., heavy oil or tar sand, and (2) to identify deposits which would be suited to a more detailed characterization study similar to the Trapper

Canyon study. This project is also partially funded by the U.S. Department of Energy, Laramie Projects Office.

MAPS OF LANDSLIDES AND WINDBLOWN DEPOSITS AVAILABLE

The Environmental Geology Section of the Wyoming Geological Survey has released eleven 1:250,000 scale maps of landslides and windblown sand deposits for portions of Wyoming. These preliminary maps are available as blue line open-file reports, and the landslides and windblown deposits are plotted on the following 1° x 2° topographic map sheets (AMS Series):

Open-file Report	84-1	Wyoming half of Ogden 1° x 2° sheet
	84-2	Wyoming half of Preston 1° x 2° sheet
	84-3	Driggs 1° x 2° sheet (landslides only)
	84-4	Rock Springs 1° x 2° sheet
	84-5	Lander 1° x 2° sheet
	84-6	Thermopolis 1° x 2° sheet (landslides only)

84-7	Cody 1° x 2° sheet (landslides only)
84-8	Rawlins 1° x 2° sheet
84-9	Casper 1° x 2° sheet
84-10	Sheridan 1° x 2° sheet (landslides only)
84-12	Gillette 1° x 2° sheet

Cost for each sheet is $3.00. For First class mailing add $1.00 for each $5.00 of purchase cost ($1.00 minimum).

These preliminary maps have been compiled from published reports and maps, aerial photography, and field checking. Field checking will continue this summer.

GEOLOGIC INDEX MAPS PROVE POPULAR

Two more indexes to geologic maps in Wyoming have gone to the printer. These newest additions to the Wyoming Geological Survey's (Map Series No. 9) depict selected geologic maps that are published as either U.S. Geological Survey Bulletins or as Professional Papers and were prepared by Survey stratigrapher, Rodney H. De Bruin. This brings the total to eight index maps in the MS-9 series:

MS-9A U.S. Geological Survey Coal Resource Occurrence and Coal Development Potential Open-file Reports (CRO-CDP) - 1981.

MS-9B U.S. Geological Survey Geologic Quadrangle Maps (GQ) - 1981.

MS-9C U.S. Geological Survey Miscellaneous Field Studies Maps (MF) - 1981.

MS-9D U.S. Geological Survey Miscellaneous Investigations Maps (I) - 1983.

MS-9E U.S. Geological Survey Hydrologic Investigations Atlases (HA) - 1983.

MS-9F U.S. Geological Survey Water Supply Paper Maps (WSP) - 1983.

MS-9G Selected U.S. Geological Survey Bulletins with geologic maps - in press.

MS-9H Selected U.S. Geological Survey Professional Papers with geologic maps - in press.

Each map in the series sells for only $2.00. For First Class mail add $1.00 for each $5.00 of purchase ($1.00 minimum).

The next three indexes planned for the series are index maps of U.S. Geological Survey Oil and Gas Maps, U.S. Geological Survey Open-file Maps and geologic maps published by the Geological Survey of Wyoming.

To compliment the index maps, the Geological Survey of Wyoming also sells all the U.S. Geological Survey Geologic Quadrangle Maps as well as selected maps in the MF, I, HA, and WSP series. These maps are only sold prepaid through the mail, but a phone call to (307) 766-2286 will identify which ones are available and their cost.

PRICE INCREASES PLANNED

We are sorry, but on August 1, 1984, the prices for many publications of the Geological Survey of Wyoming will increase. Costs of publishing, mailing, and maintaining an inventory of books and maps have made the increases necessary. If there is something you have put off buying, now is the time to order it.

NEW SURVEY PUBLICATIONS

Self-guided tour of the geology of a portion of southeastern Wyoming, by W. Dan Hausel and Richard W. Jones, Public Information Circular No. 21, 1984 ($6.00).

Oil shale sample locations and analyses, southwest Wyoming and northwest Colorado, by Donna J. Sinks, Laurence G. Trudell, and George F. (Pete) Dana, Public Information Circular No. 22, 1983 ($6.00).

Metallogeny of some Wyoming deposits, by W. Dan Hausel and Ray E. Harris, Reprint No. 44, 1983 ($3.00).

Geothermal resources of Wyoming, by H.P. Heasler, and others, colored map, 1:500,000 scale, 1983 (Free, except for $2.00 mailing charge).

Alteration and mineralization associated with sandstone uranium occurrences, Morton Ranch area, Wyoming, by Ray E. Harris, Report of Investigations No. 25, 1984 ($7.00).

Bibliography of Wyoming geology, 1960-1969, by Charlotte Tancin, Bulletin 64. 1984 ($8.00).

Almond and Frontier tight gas sand cross sections, Greater Green River Basin, Wyoming, by Alan J. Ver Ploeg, Rodney H. De Bruin, Robert L. Oliver, and Michael Clark, Open-file Report 83-5, 1983 ($25.00).

Add $1.00 for each $5.00 of purchased price if mailed First Class ($1.00 minimum).

WYOMING URANIUM PRODUCTION FORECAST TO 1990[1]

Calendar Year	Gross Uranium Production (millions of tons)
*1981	4.6
*1982	2.1
1983	1.6
1984	1.0
1985	0.8
1986	0.8
1987	0.9
1988	0.9
1989	1.0
1990	1.3

*These are actual values for comparison.

[1] Forecast by Wyoming Geological Survey, December, 1983.

WYOMING TRONA PRODUCTION FORECAST TO 1991[1]

Calendar Year	Gross Trona Production (millions of tons)
*1981	11.8
*1982	10.1
*1983	11.6
1984	11.7
1985	11.8
1986	11.8
1987	11.9
1988	11.9
1989	12.0
1990	12.0
1991	12.1

*These are actual values for comparison.

[1] Forecast by Wyoming Geological Survey, June, 1984.

PERCENTAGE OF WYOMING'S TOTAL MINERAL VALUATION BY COMMODITY FOR 1983 AND 1973

	1983*	1973
Oil	56.5%	75.5%
Gas	20.1%	9.0%
Total Hydrocarbons	76.6%	84.5%
Coal	19.8%	4.0%
Trona	2.2%	3.3%
Uranium	0.8%	5.2%
Iron	0.2%	1.7%
Bentonite	0.2%	0.5%
Sand and Gravel	0.1%	0.1%
Phosphate	-0-	0.2%
All others	Less than 0.1% (Limestone, Dolomite, Gypsum, Sugar Rock, Clay, Sodium Sulfate, Feldspar, Decorative Stone, Cement Rock, Scoria, and Ballast.	0.4% (Dolomite, Gypsum, Clay, Sodium Sulfate, Feldspar, Decorative Stone, Cement Rock, Scoria, and Ballast)
TOTAL VALUATIONS	$5,624,803,530	$511,953,563

Notable in the above figures are the relative declines in the proportions of uranium and iron to the total, and the relative increases in the proportions of coal and natural gas. *Valuation is based on 1982 production.

WYOMING COAL PRODUCTION FORECAST TO 1990 (MILLIONS OF TONS)

	1981[1]	1982[1]	1983[1]	1984	1985	1986	1987	1988	1989	1990
Campbell County	71.6	81.2	88.2	93.4	103.2	110.5	117.2	112.0	122.8	123.8
Converse County	3.6	3.4	2.7	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Sheridan County	2.8	3.0	2.9	2.9	2.2	2.2	2.5	3.0	3.0	3.0
Carbon County	8.5	5.0	4.8	4.6	4.6	3.7	3.8	5.1	5.6	5.6
Sweetwater County	11.2	11.0	9.5	10.0	8.1	9.1	9.1	11.0	11.0	11.0
Lincoln County	5.0	4.3	4.0	4.1	4.4	4.6	4.9	5.2	5.2	5.2
Hot Springs County	M[2]	M	M	M	M	M	M	M	M	M
Total Wyoming	102.8	107.9	112.2	118.3	125.8	134.4	141.8	149.6	150.9	151.9
Increase per year	9%	5%	4%	5%	6%	6%	5%	5%	1%	1%
Estimated contracted production	110.0	119.0	122.6	128.6	137.1	142.6	147.6	149.6	150.9	151.9
Below contract	7%	9%	8%	8%	8%	6%	4%	-0-	-0-	-0-

[1] These are actual values for comparison. [2]M means minor tonnage (less than 0.1 million tons). Forecast by Wyoming Geological Survey, March, 1984.

MINERAL RESOURCE AND RESERVE BASE ESTIMATES FOR WYOMING

PETROLEUM

Remaining Resources (January 1, 1983)

Discovered (Includes 10 billion barrels recoverable by enhanced recovery techniques)	13.7 billion barrels[1]
Undiscovered	7.6 billion barrels[1]
Total	21.3 billion barrels

Remaining Reserve Basin (January 1, 1983)

Measured reserves (Proved reserves)	0.9 billion barrels[2]
Indicated and inferred reserves	2.8 billion barrels[3]
Total	3.7 billion barrels

NATURAL GAS

Remaining Resources (January 1, 1983)

Discovered	21.0 trillion cubic feet
Undiscovered (there is another 35 trillion cubic	

feet of noncombustible CO_2 gas)	58.0 trillion cubic feet
Total	79.0 trillion cubic feet

Remaining Reserve Base (January 1, 1983)

Measured reserves (Proved reserves)	10.2 trillion cubic feet

COAL

Remaining Resources (January 1, 1984)

Identified (Discovered)	136.5 billion tons[4]
Undiscovered	800.0 billion tons[5]
Total	936.5 billion tons

Remaining Reserve Base (January 1, 1984)

Demonstrated strippable (Measured and indicated reserve base)	27.6 billion tons[4]
Demonstrated underground-minable (Measured and indicated reserve base)	38.4 billion tons[4]
Total	66.0 billion tons

(table continued on next page)

TRONA

Original Resources

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

URANIUM

		U_3O_8
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]

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

2 American Petroleum Institute, 1983, Basic petroleum data book: Volume III, no. 2, May.

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

4 Wyoming Geological Survey, June, 1984. (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.

1983 WYOMING COAL PRODUCTION BY COUNTY AND BY COAL BASIN[1]

County	Production	Percent of Total Production	Number of Mines	Number of Employees
		POWDER RIVER BASIN		
Campbell	88,180,758	78.6	14	2,610
Converse	2,684,011	2.4	1	247
Sheridan	2,947,698	2.6	2	214
TOTAL	93,812,467	83.6	17	3,071
		GREEN RIVER BASIN		
Sweetwater	9,471,416	8.4	3	994
		HAMS FORK REGION		
Lincoln	4,040,435	3.6	2	477
		HANNA BASIN		
Carbon	4,818,465	4.3	6	767
		BIGHORN BASIN		
Hot Springs	45,091	<0.1	1	4
TOTAL WYOMING	112,187,874	100	29	5,313

[1]Source: Wyoming State Inspector of Mines, preliminary data from 1983.