UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

QUARTERLY REVIEW

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Proposed Wilderness May Hide Oil

By Howard Ritzma

The possibility of petroleum being present *beneath* the proposed *High Uintas Wilderness Area* has been suggested by John C. Osmond, Salt Lake City, consulting geologist, in communications to the U.S. Forest Service, U.S. Geological Survey and the Utah Geological and Mineralogical Survey.

Dr. Osmond's concern is prompted by development of the Bridger Lake Oil Field, discovered in 1966 by Phillips Petroleum, about *seven* miles north of the proposed wilderness area boundary.

The discovery well in the field was completed in January, 1966, flowing 2753 barrels of oil per day from Dakota Formation (Cretaceous) sands at 15504-15517 and 15555-15586. A second well has been completed in the field; another is close to completion, after being delayed because of mechanical difficulties, and a fourth well is close to total depth. Drilling and completion of wells is slow and costly. However, plans for another wildcat test in the area have

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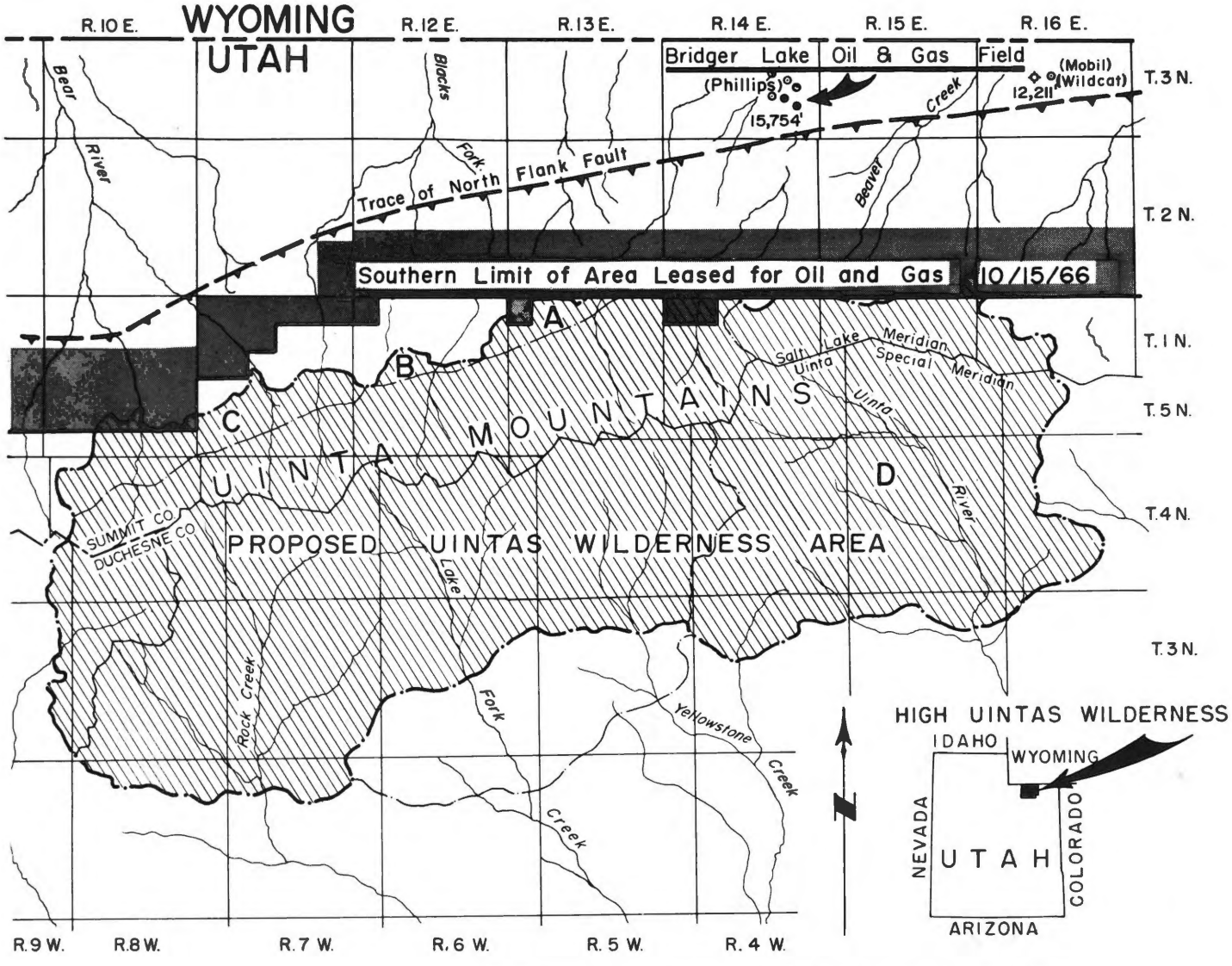

A, B, C and D indicate Forest Service designation

(Continued from page 1)

been announced by Mobil Oil and are rumored for Shell Oil.

Bridger Lake Field is presumed to be located on an anticline immediately north of the large North Flank Fault which separates the Uinta Mountain Uplift from the adjacent Green River Basin to the north. In this locality, the fault has at least a 20,000-foot vertical displacement and an unknown horizontal component of movement. Thick glacial gravel and morainal deposits conceal the anticline and the exact location of the fault. The attitude (dip) of the fault thus is open to conjecture.

REVERSE FAULTS

Dr. Osmond has cited published papers by several authors who describe the faults flanking the Uinta Mountains as high angle reverse faults or low angle overthrusts. These contentions are based on field evidence 30 miles east of Bridger Lake Oil Field where the Henrys Fork and Uinta faults flank the Uinta Mountain Uplift.

In a report to the U.S. Forest Service placed on open file October 10, 1966, the U.S. Geological Survey described the North Flank Fault as a north-dipping normal fault thus implying that, with depth, the Green River Basin recedes northward toward the Wyoming-Utah boundary. Reportedly, the USGS has reviewed this interpretation in the light of published work (some its own) and now will describe the fault as a reverse fault.

UNDER WILDERNESS

If — as Dr. Osmond contends — the North Flank Fault is a reverse fault and not a normal fault, oil and gas accumulation in the Bridger Lake Area could continue for some distance south of the fault's projected surface trace.

If the fault were to dip south at a particularly low angle, the oil- and gas-bearing reservoir sands of the Green River Basin *could extend beneath the proposed High Uintas Wilderness Area.*

Dr. Osmond has pointed out a surprising pattern of oil and gas leasing activity following the Phillips discovery.

Federal oil and gas leases have been applied for and issued to several major oil companies on land two to four miles south of the indicated surface trace of the North Flank Fault. Brokers and independents "following the play" have in places pushed leasing three to five miles farther south of those held by the major companies.

Information developed by Dr. Osmond shows oil and gas leases covering all or part of 19 sections within the proposed wilderness area. Some of these leased sections are as much as seven miles south of the indicated trace of the North Flank Fault at the surface.

This leasing clearly indicates that information — probably developed by reflection seismograph surveys — is convincing enough to stimulate sizable expenditure of lease money south of the North Flank Fault.

The nature of the faulting bounding the Uintas on the north — whether normal, high angle reverse or low angle overthrust — thus assumes great importance.

Mr. Ritzma

A specialist in the geology of northeastern Utah and adjoining Colorado and Wyoming, Mr. Ritzma has authored several papers on the geology of the region surrounding the Uinta Mountains, including UG&MS Bulletin 66, *The Geology of Daggett County, Utah.*

Prior to joining the Survey, he pursued his profession as a consulting petroleum geologist in Denver, Colo. Over the past 17 years, he has been associated with several consultng groups and independent and major oil companies.

From 1954-55, he was employed in Salt Lake City by General Petroleum Corp. (Mobil Oil) as a district geologist for the Great Basin.

Mr. Ritzma, his wife and their two children make their home at 4100 Morningstar Dr. Mrs. Ritzma, the former Barbara Robinson, is a graduate of the University of Utah.

One of Utah's more prolific oil producing areas may be found to extend south beneath Precambrian outcrops where few oil men would have seriously considered exploration in past years. Creation of the wilderness area as proposed would preclude exploration activity to discover and exploit these resources.

In the initial mineral resource surveys of the proposed High Uintas Wilderness Area, petroleum possibilities scarcely rated a mention. However, with oil and gas leases crowding the proposed wilderness on the north and extending into it in places, conflict between petroleum exploration and the wilderness concept appears to be taking shape.

Survey Study Under Way At Salt Flats

At the request of Gov. Calvin L. Rampton, the UG&MS is commissioned with determining what effect, if any, *brine withdrawal* by canals along the salt pan periphery may have upon the salt crust at the Bonneville Salt Flats.

Observations of the salt surface under differing weather conditions were initiated in November of last year. Both Dr. Armand Eardley, Univ. of Utah Geology Department, and Bruce N. Kaliser, engineering geologist, UG&MS, are engaged in this investigation.

Information has been compiled from several sources. Photomosaics and an isopach map of the salt thickness have been prepared. Geologists with Kaiser Corp. and the State Highway Department Materials Section have been consulted for additional information.

At the present time, the Survey is formulating plans for field work to be undertaken this summer. As the solution to the problem lies in *brine movement,* direction and rate, hydrogeological techniques will be employed.

Familiar Ring? . . . 1910 News!

"From about 1900 until 1904 fears were expressed that the Great Salt Lake was doomed to extinction, and that it would be a matter of only a few years until its site would become a salt desert.

The recession of the shore line and sinking of the lake level continued until the autumn of 1903.

Since that time there has been a rise in the level of the lake, and during the year just ending new fears have arisen — fears that large engineering works like the Lucin cutoff of the Southern Pacific and the roadbed of the Western Pacific railroad would have to be abandoned.

A succession of years with abnormally high rainfall is responsible for the con dition now existing."*

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*"Analysis of Salt Lake Water," by Dr. W. C. Ebaugh, in *The Mining Review,* Salt Lake City, Utah, Sept. 30, 1910.

Geophysics, Mineral Exploration Tool

Author's note: The purpose of this article is to summarize geophysical methods used in exploring the Utah minerals, with emphasis on exploration for ground water, metallic and nonmetallic minerals.

A second article — devoted to the use of geophysics in the exploraton for petroleum, natural gas and other hydrocarbons in Utah -- will appear in a future issue of the *Quarterly Review.*

Each of the geophysical methods in common use today is reviewed from the standpoint of the principles involved. When possible, examples are cited of the usefulness of a method to specific problems, areas or districts in Utah.

Finally, the potential of a particular method as an aid to the future development of the State's mineral resources is evaluated. No attempt is made to include all Utah geophysical surveys or their published results. A compilation of such surveys will appear in a future issue of the *Quarterly Review.*

By Kenneth L. Cook*

Every geophysical exploration method involves the measurement of a physical property related to near-surface rocks, to a force field of the earth[1] or both.

Measurements generally are taken at discrete points, or stations, in an orderly manner along previously planned profiles, traverses or on a grid pattern. However, most often geophysical data are represented on profiles and maps.

Measurements may be taken *on, above or below* the surface of the earth. Many geophysical instruments are carried in the field by hand, of course, but to permit continuous recording, some are mounted in ground, air and water vehicles and — most recently — in missiles.

Any departure from normal readings is termed "an anomaly." Anomalies occur in areas where the physical properties of underlying rocks differ from those of normal rocks. For this reason, usually, they are related to changes in rock types or composition, possibly related to mineralization.

GRAVITY METHOD

The gravity method of geophysical exploration involves the measurement of changes in *gravitational acceleration* at various points on the earth's surface.

Gravity anomalies are caused by changes in the density of underlying rocks, and, when a significant density change occurs, can be observed over such features as faults, anticlines, synclines, etc.

In Utah, large gravity anomalies are noted over and adjacent to Basin and Range faults commonly occurring along the steep fronts of mountain ranges, such as the Wasatch front.

An anomaly — one of the most pronounced in the United States — with a change of about 50 mgal[2] in a horizontal distance of 5 miles, occurs along the great fault zone and extends along the west side of Utah Lake between Pelican Point and Saratoga Springs. This fault zone forms the west margin of the Utah Valley graben.

Large gravity anomalies facilitate the charting of Utah's Basin and Range faults and — with moderate accuracy — help establish the thickness of fill beneath large intermontane valleys.

Gravity surveys aid ground-water studies in Utah, because the circulation or impounding of such water is closely related to the location of major faults and valley fill thickness.

In the Great Salt Lake area, gravity surveys have been used to delineate Cenozoic structural basins, where economic saline deposits may occur at depth.

Gravity studies can directly or indirectly assist in the exploration for metallic ore deposits.

For example, a mining company wishing to explore for mineralization at depths less than 1000 feet, could use the indirect assistance of gravity surveys. Areas where valley fill is of the prescribed depths could be delineated by gravity surveys and exploration restricted to such regions.

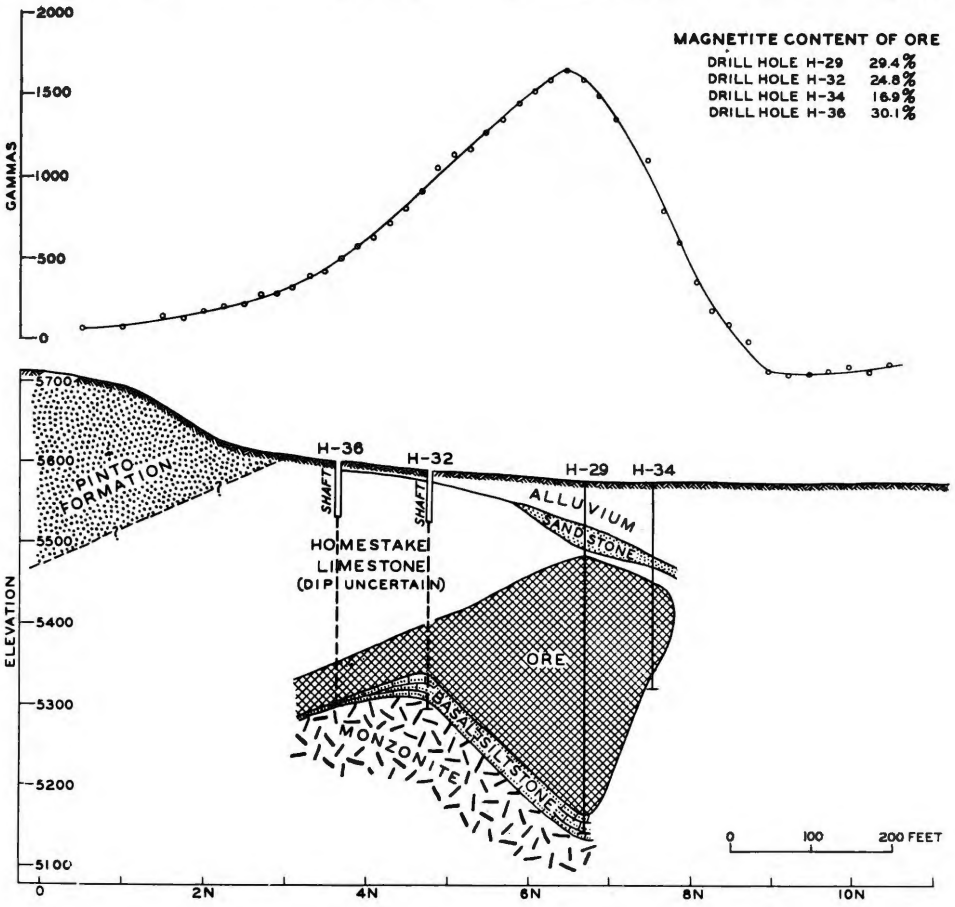

Figure 1. - Magnetic profile and geologic cross section along traverse 28.00 W, Short Line ore body, Desert Mound area, grid 19. (Topography and geology after W. E. Young and Geophysics by K. L. Cook.)

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Gravity surveys can provide direct assistance by outlining broad areas favorable for mineralization, for example, regions of large igneous intrusives etc.

Recent gravity surveys in the Iron Springs district, Utah, showed an extensive gravity high. That high is continuous throughout the region between the outcrops of quartz-monzonite-

(Continued on page 4)

*Professor an chairman, U. of U. Departmen of Geophysics.

[1]A force field can be magnetic, electric, radioactive, gravitational, etc.

[2]The unit of acceleration used is the milligal (mgal), which is one thousandth (1/1000) of a gal (1 cm. per sec. per sec.), named in honor of Galileo.

(Continued from page 3)

porphyry mass probably joins all three at relatively shallow depths.

In a direct way, also, gravity surveys can assist in the discovery and delineation of massive ore bodies of high density, such as sulfide and magnitite-hematite iron ore deposits.[3]

MAGNETIC METHOD

The magnetic method of geophysical exploration involves measurement of changes in the magnetic field at various points on the earth's surface.

Magnetic anomalies are caused by changes in the magnetic susceptibility[4] of underlying rocks.

In Utah, magnetic surveys have been extremely successful in the exploration for iron ore deposits in the Iron Springs district. Here the large ore bodies occur in limestone adjacent to the quartz-monzonite-porphyry intrusives. Magnetic anomalies exceeding 1500 gammas[5] generally occur over such near-surface iron ore bodies. The iron ore itself is a mixture of magnetite, a magnetic iron mineral, and non-magnetic hematite.

[3]A bouguer gravity map of the entire state of Utah is planned by the author. Workers have completed a considerable amount of gravity coverage.

[4]Magnetic susceptibility is a measure of the degree of magnetism of a substance.

[5]The unit of magnetic field intensity (or number of lines of force per sq. cm.) is a gamma, which is equal to 0.00001 oersted. The earth's magnetic field (vertical component) in Utah ranges from about 48,000 to 53,000 gammas.

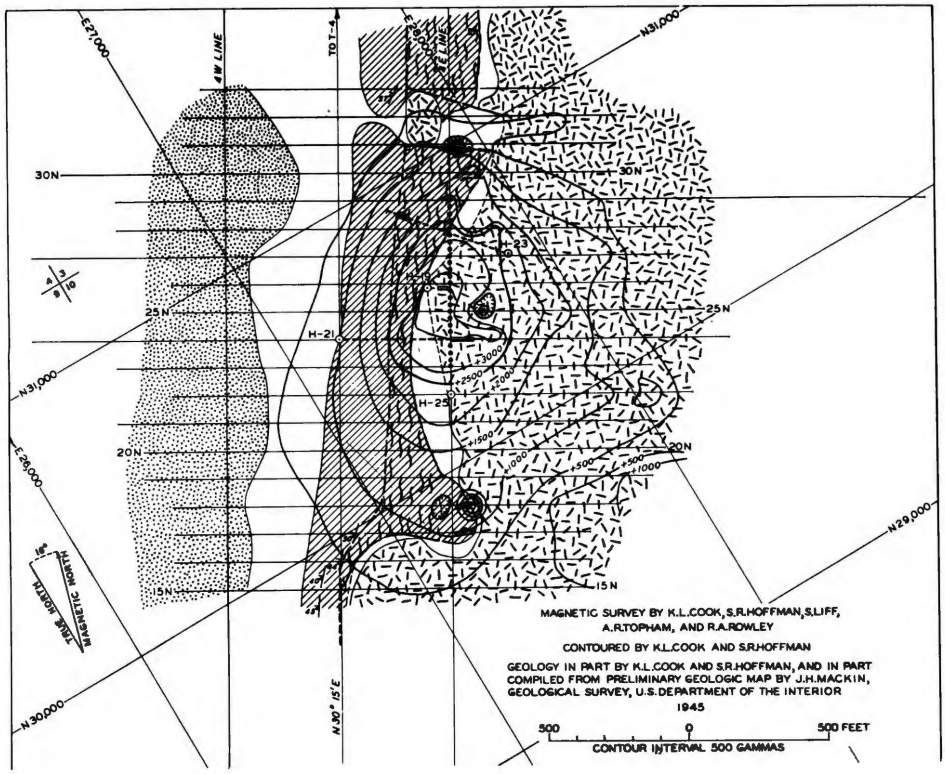

Figure 3. - Magnetic and geologic map of April Fool claim area, grid 10, Three Peaks, and geophysics by K. L. Cook.

ELECTRICAL METHODS

Electrical methods of exploration are based on changes in the electrical properties of rocks — resistivity, dielectric constant, "polarizability," etc. — and may be classified broadly as those which involve the measurement of either (1) the electrical properties of naturally occurring phenomena or (2) artificially produced electrical phenomena.

Classified under (1) are:

—The self-potential method: measurement of the electrical potentials on or in the earth, arising from various electrochemical processes associated with ore bodies, such as sulfides;

—The telluric current method: measurements of the broad sheet-like current flow along the earth's surface;

—The AFMAG (audio-frequency magnetics) method: measurements of the moderately high-frequency (500 cycles per sec.) effect of distant thunderstorms on the ground.

Included in (2) are:

—The resistivity method: measurement of the ground's resistivity to an artificial current (direct or commutated) impressed in the earth;

—The electromagnetic method: measurement of an oscillating electromagnetic field impressed into the ground, usually inductively with transmitting coils (horizontal or vertical loop techniques);

—Induced polarization: measuremen of a current pulsed into the earth (time domain) or impressed into the earth at different frequencies (frequency domain);

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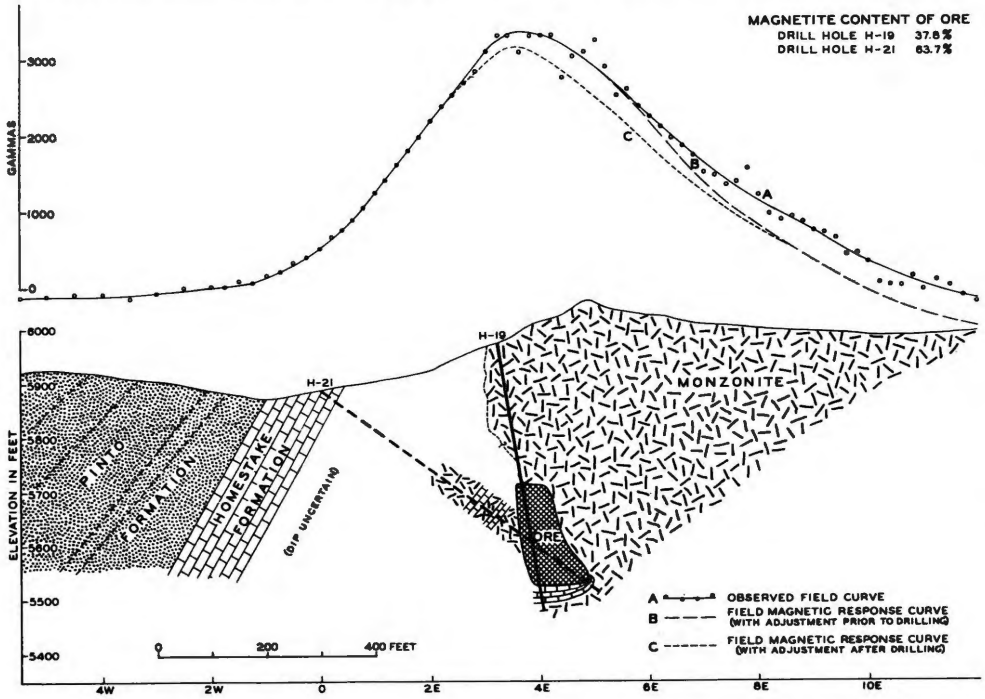

Figure 2. - Magnetic profile and geologic cross section along traverse 26.00 N, April Fool ore body, grid 10. (Topography after W. E. Young and J. H. Mackin. Geology in part after W. E. Young, and Geophysics by K. L. Cook.)

LANDS AND WINDS OF CHANGE

Editor's note: William W. Porter II has written a review of the history of American public domain lands and various ramifications of recent federal policies.[1] These policies are of particular concern to the residents of Utah, because 70 percent of all land in this state is federally owned. Mrs. Smith's article for the *Quarterly* has been drawn from Mr. Porter's material. The full text is readable and informative and is recommended highly for the reader's consideration.

By Bernice Y. Smith*

The public domain is government owned land held for distribution to the people.

Mr. Porter points out that traditional Federal public domain policies were incorporated into both the Articles of Confederation in 1777 and the Constitution (Article IV, Section 3, Clause 2). Further, rights of those seeking to develop mineral resources on public domain lands were assured by the Mining Law of 1872.

Traditionally, the Congress has had complete and undisputed control of the domain. Land has been disposed of to individuals in order to encourage private settlement and development of natural resources for the national good.

FEDERAL RIGHTS

At the same time, the government has retained the right to tax, zone, condemn and regulate the land.

It was under these policies that we developed natural resources essential to our economic growth and national security.

Revenue from various direct and indirect taxes on these lands has been an important source of financial support for our government.

However, recent developments in policy concerning the Federal public domain are of great concern to many exploration and mining geologists and, in Mr. Porter's opinion, pose a serious threat to our national security. As he sees it, the new policy seems to be one of non-disposal, with the Executive Branch of the government (through the agency of the Bureau of Land Management) apparently seeking control formerly held by Congress.

The Federal government owns more than 400 million acres of land in the 48 contiguous states — nearly half of all land west of the Rockies; 70 percent of the land in Utah and more than 99 percent of the land in Alaska.

Public Domain

According to Mr. Porter: the government expects to dispose of only 10 million of the 350 million acres of public domain land — only 2½ percent — in the next 50 years; new difficulties are arising in filing on public lands and in maintaining allowed claims; the Multiple Use Act of 1964 gives the Federal government the right to put vast areas of land into a single specific classification and withdraw it from use for any other purpose, implying that the mineral production thereon is to be managed without being subject to the mining and mineral laws.

'WISE USE'

Mr. Porter finds the basic attitude reflected in this act to be that government can better manage lands for the good of all people. Such government ownership, management, operation and control is Socialism and is diametrically opposed to the beliefs that have made our nation great.

The author points out that whereas most Americans believe in the "wise use of our natural resources," there are those who doubt that restricting huge tracts of land for recreation or wilderness uses — without regard for the economic resources they may contain — constitutes "wise use."

Mr. Porter's review notes that our natural resources are finite; it is often impossible to predict — even 10 years in advance — just what will become a mineral resource; a national calamity could result if experts are not allowed access to our federal domain to explore for and develop our natural resources.

FUTURE NEEDS

He is convinced that known supplies of natural resources will *not* be adequate for future emergencies. To wait until an emergency arises before permitting exploration and development he terms "national suicide" as there won't be time.

Widespread concern over these developments and a flood of complaints from people directly involved recently resulted in establishment of a Congressional Public Land Law Review Commission. Congressman Wayne N. Aspinall of Colorado chairs that committee. To date, Committee hearings have dealt with overall philosophy (disposal or non-distribution) and with administrative details.

To summarize, Mr. Porter contends that:

—A trend toward Socialism is evident in recent legislation — (1) The government is allowed to set up business on its oil and mineral lands as well as lands needed for industrial, commercial and urban uses; (2) The government can determine which lands to dispose of for industrial use and which to retain and manage for its own industrial use.

—Solution of these problems does not require extensive legislation, but rather a return to traditional policies.

—Withdrawal of land for "classification" has been excessive and largely unnecessary.

—The public interest would be better served by such methods than by continuing to hold needed land unproductive and depriving local schools of badly needed income from taxes.

'Free Gold'

"There is no mining camp since Cobalt which was not first pointed up by diligent *government* geologists," Arnold Hoffman wrote in his story of Canadian mining, *Free Gold.*

"The technician has performed with esteem in the selection of entirely new mineral areas . . . ," he said.

"In the early days Ottawa and the provinces were handicapped by limited resources and could employ only a handful of faithful men . . . even these small groups supplied the clues which led to major developments later. . .

"With more parties in the field as the country expanded, prospecting resolved itself into following the suggestions contained in the ever-swelling numbers of government reports.

"Quebec, Red Lake, Little Long Lac, Pickle Crow, northern Manitoba, Yellowknife and even remote Labrador first heard the sound of the geologist's pick before the prospector appeared on the scene," he concluded.

* * *

Right To Explore

The Office of Minerals Exploration has approved a contract and loan which will enable Thomas P. Miller of Salt Lake City to explore for silver at the Vipont Property in Box Elder County. Total cost of exploration has been estimated at $79,000, in which the government participates 75 percent.

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*Secretary, U. of U. Department of Geology.

[1]"The Public Domain, Heart of the Republic," *American Forests;* Jan., Feb., March and April, 1966, 26 p.

Giant Fault Straddles S. L. Lifeline

By Bruce N. Kaliser*

Straddling individual branch faults comprising the great anastomosing Wasatch Fault Zone are important arteries of the Salt Lake Valley lifeline — its water supply and storage facilities.

Important and necessary additions to this "lifeline" frequently are planned without respect for this *major* fault zone despite the fact that much now is known about it.

The map included shows proposed additions as well as existent water facilities within the fault zone.

While there is no need to subscribe to the alarmist's view of this geological phenomenon, there is *every need* to give it justifiable consideration.

Evidencing this, Williams and Tapper of Utah State University assign a total of 52 earthquakes to the Wasatch Fault Zone for the centenary, 1850-1949. More recently, Cook and Smith of the University of Utah Geophysics Department, in an extended study using more accurate present-day instruments, attributed 53 earthquakes to the zone for the 15-year period extending from mid-1950 to mid-1965.

Latest earthquake studies seem to indicate that recent seismic activity is somewhat concentrated in the extreme western portion of Utah where population is sparse. However, geologists unanimously agree on impending recurrent movement along much of the fault zone in areas housing more than 85 percent of the state's population. The freshness and steepness of scarps, largely without vegetation, show a displacement graphic enough to convince any layman.

Of significance, also, is a displacement of one centimeter in three years detected at the mouth of Big Cottonwood Canyon by members of the University of Utah's Civil Engineering Department.

In the same area, intersection of the fault with the Deer Creek Aquaduct is believed to have been responsible for parted joints which necessitated at least one disinterment of the pipeline.

The great San Francisco earthquake and the fire that followed emphasize the need for water supply systems capable of surviving an earth shock.

Each of the integral parts of the Salt Lake City water system deserves individual consideration as to its placement. Then should any one or several of the intertwining branches of the Wasatch Fault Zone move, the arterial system of this vital lifeline will be preserved.

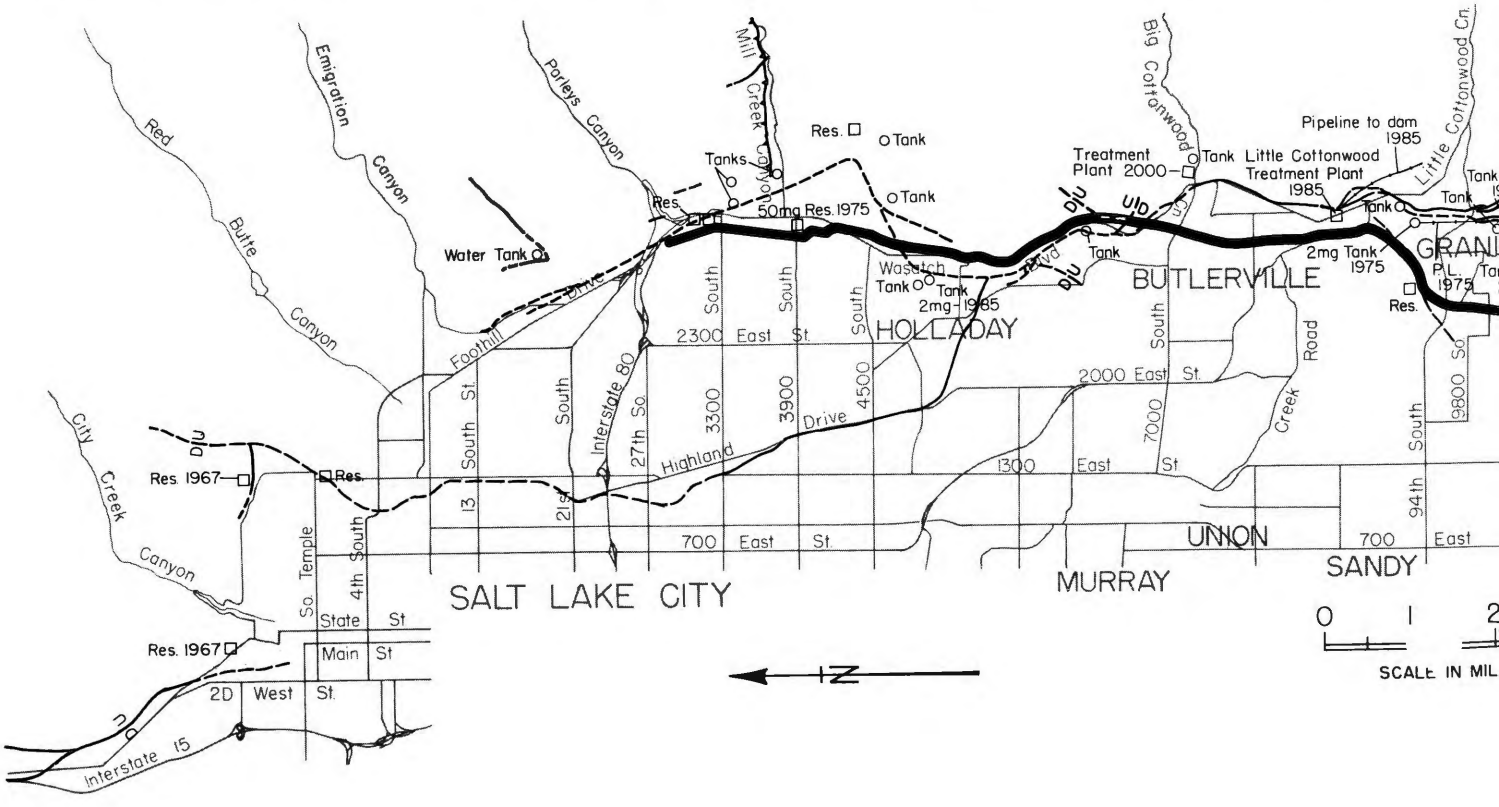
*Engineering geologist, Utah Survey.

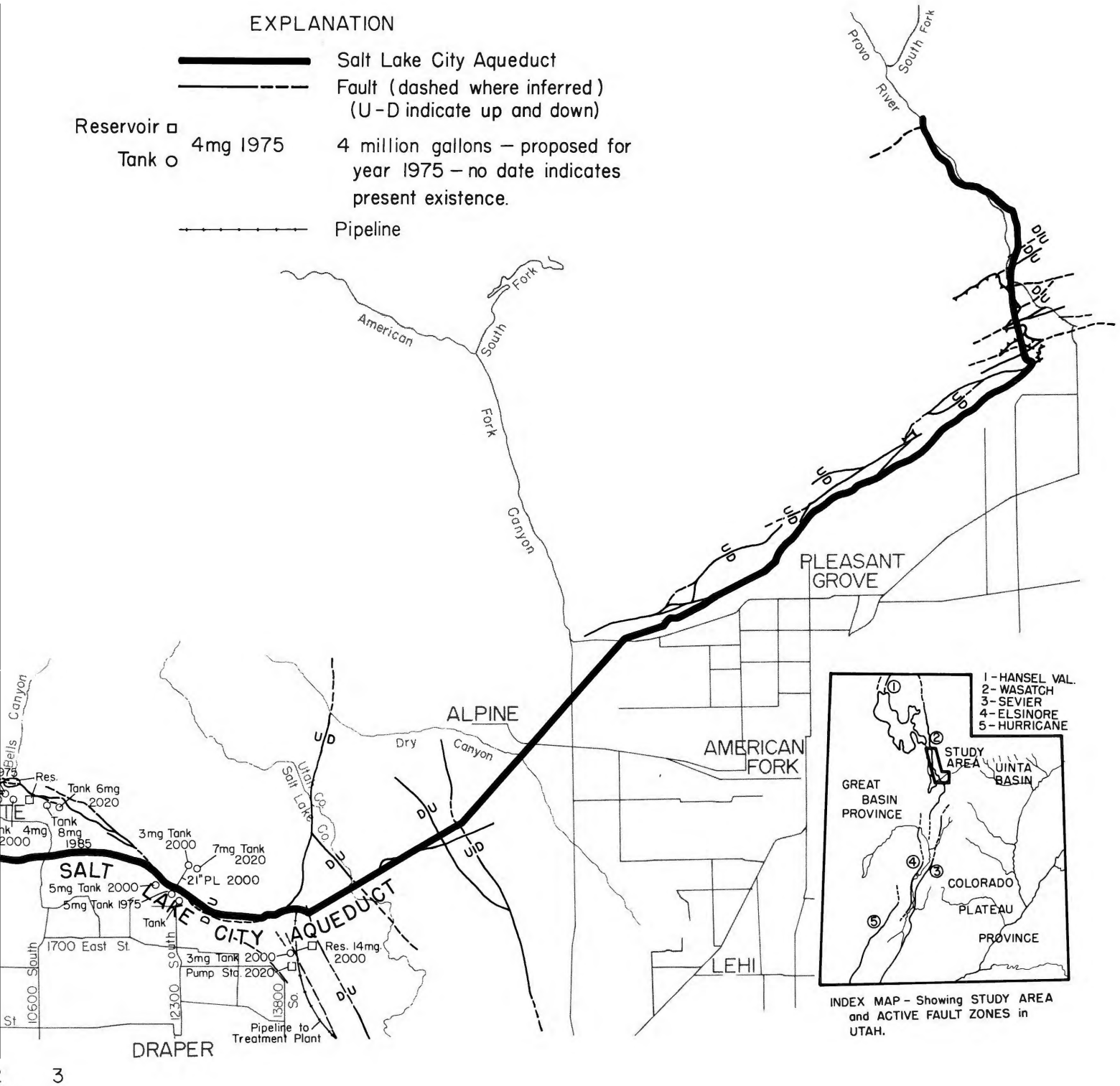
UTAH EARTHQUAKE HAPPENINGS IN 1967

Date	*Place*	*Richter Magnitude**
Jan. 15	Salt Lake City	1.0
Jan. 22	North of Nephi	2.7 (Five small aftershocks the same day)
Jan. 27	Salt Lake City	
Feb. 4	Logan	1.0
Feb. 5	Logan	1.5
Feb. 9	Logan	1.5
Feb. 10	Salt Lake City	1.5
Feb. 13	Price	1.0
Feb. 15	Southeast of Vernal, Utah-Colorado border	2.5 (Probably rock burst)
Feb. 15	Price	4.2
Feb. 15	West of Logan, Wyoming-Utah border	2.3 (Probably rock burst)
Feb. 16	West of Enterprise, Utah-Nevada border	3.0 3.0
Feb. 16	Promontory Point	4.0
Feb. 18	Logan	1.5
Feb. 19	Promontory Mts.	3.0
Feb. 20	Logan	1.5
Feb. 21	Northeast of Ogden	3.0
Feb. 21	Logan	1.5
Feb. 22	42 miles west-northwest of Logan	3.0
Feb. 24	Wyoming, 140 miles east of Logan	2.8
Feb. 24	Logan	1.5
Feb. 25	Logan	1.5
Feb. 26	Near Logan	2.9
Feb. 27	Wyoming, 60 miles east of Logan	3.2
Feb. 28	Logan	1.5
March 4	Ogden, felt in Huntsville	3.5
March 6	Near Salt Lake City	1.0
March 7	Near Salt Lake City	1.0
March 9	Near Salt Lake City	2.5-3.0
March 10	Near Salt Lake City	1.0

*Richter magniture of the 1906 San Francisco earthquake ranged between 8.2-8.3. Shown recorded magnitures are so small as to be scarcely noticeable. Locations and magnitures are general. No final determinations.

Source: University of Utah, Geophysics Department.





INDEX MAP - Showing STUDY AREA and ACTIVE FAULT ZONES in UTAH.

Editor's Note: Readers are invited to contribute short items of pertinence to "Diggin's," which the Survey intends to keep as a regular *Quarterly* feature.

Drilling in the Bridger Lake Fork Unit, Summit County, has continued through the winter months with Phillips Petroleum reporting two active locations. The No. 3-A well in NWNWNW Sec. 25, T-3-N, R-14-E, has been completed from perforations at depths between 15,524 and 15,595 feet. Oil flowed at a rate of 881 barrels per day through a 17/64-inch choke from these perforations in Lower Dakota sands with no water. Phillips No. 4-A Unit in SENWNW Sec. 26, T-3-N, R-14-E, is at 15,654, fishing for stuck drill pipe.

Phillips has announced location for two additional wells, No. 5-A Unit in NESWSE and No. 6-A Unit in NESWNW, both in Sec. 23, T-3-N, R-14-E. These two wells are scheduled to be drilled to 15,800 and 15,870 feet respectively. The No. 5-A Unit is reported drilling below 1000 feet. Eight miles east of the Phillip's field, Mobil Oil is drilling below 6350 feet at their No. 1 Gregory well in the Burnt Fork Unit. Mobil plans to drill 15,650 feet to test Dakota sands.

Shell Oil has announced location for a 16,000-foot Dakota test two miles west of the Bridger Lake Field.

To the end of 1966, production from the No. 1 Unit (discovery) well in the Bridger Lake Fork Unit totalled 165,961 barrels of oil. In December, 19,783 barrels were produced for an average of 638 barrels daily flowing; and in January this total rose to 23,055 barrels averaging 744 barrels daily flowing. Production of the No. 2 well has not been made public.

Utah's proved recoverable reserves of crude oil stood at 589,956,000 barrels on January 1, 1967, according to estimates published by the Oil and Gas Journal in its annual Forecast/Review, January 30, 1967. This represents a decrease of 354,000 barrels from the estimate of reserves at the beginning of 1966 (adjusted to compensate for discoveries, revisions and extensions, and 1966 production). Utah's crude oil reserve makes up 1.8% of the nation's total.

Estimates of reserves of natural gas liquids (condensate or "distillate") totalled 48,667,000 barrels, a decrease of 2,691,000 barrels from the beginning of 1966. Utah's reserve of natural gas liquids is only 0.6% of the U.S. total.

Gas reserves in Utah are estimated at 2016 cubic feet, up 25 billion cubic feet during the year. Of the nations total reserve (392,000 billion cubic feet), Utah is credited with 0.5%.

Diggin's . . .

In 1966, 73.1% of Utah's crude oil production was derived from about 656 wells in the state's two giant fields, Aneth and Red Wash. Of the state's remaining reserve of oil, 59.3% is credited to the two giant fields; 10.5% is credited to three fields, Ashley Valley, Ismay and Lisbon; and the remaining 30.2% is scattered among about 65 other fields or single wells.

Using average well-head values of crude oil, natural gas liquids and natural gas, Utah's liquid and gaseous hydrocarbon reserve has a value of about $1,850,000,000 (1.85 billion dollars).

Of the $6.7 billion in highway taxes collected in 1965 by the 50 states, taxes on motor fuel accounted for $4.4 billion, about two-thirds of the total.

A recent *Quarterly* article concerning conservation action in Little Cottonwood Canyon by Dr. Eardley of the College of Mines and Minerals Industries, prompted O. W. Tollefson, Chairman of the Department of Earth Sciences, Colorado State College, to write the following:

"I want to compliment you for taking time for such an appeal. I would hope that America will save a few more of its interesting and important landmarks throughout the nation so that the coming generations may have a few natural features to study and observe."

Among projects under consideration by the Survey's Petroleum Geologist and staff are revisions and additions to the volume "Oil and Gas Fields of Utah" published by the Intermountain Association of Petroleum Geologists in 1961.

Atlas Minerals Division of Atlas Corp. has acquired uranium leases on 135 claims owned by Four Corners Oil and Minerals Co. and on 15 claims of the Allen Nordeen group in the Green River area of Utah. The company plans an extensive exploration and development program on these properties. The Four Corners property has been the principal producer of uranium in the area over the last decade.[1]

Atlas Corp. has added a copper-concentrate circuit that recovers copper as a by-product of its uranium milling operations at Moab. The process involves an acid leach and solvent extraction of the copper.

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[1] *Mining Congress Journal*, November, 1966.

The proposed merger of Gulf Sulphur Corp. and Lithium Corp. of America will be submitted to stockholders of both companies for approval about May 1, according to directors Robert H. Allen, president of Gulf Sulphur, and Harry D. Feltenstein, Jr., president of Lithium.

The proposed agreement calls for Gulf Sulphur to be the surviving corporation and for shares of its common stock to continue as shares of common stock after the merger.

If the merger is approved, Mr. Feltenstein will become executive vice president in charge of chemical operations and a member of the board of directors. No other immediate changes are contemplated in the management of either company, and Lithium's officers will retain their present titles and management responsibilites in a wholly-owned subsidiary of Gulf Sulphur, Mr. Allen said.

Gulf Sulphur, with corporate headquarters in Houston, Texas, has produced elemental sulphur from its concessions on the Isthmus of Tehuantepec, Mexico, since 1954. Last year, the company embarked on a major exploration program to develop additional sulphur reserves in Mexico and Latin America, as well as other minerals in North America.

With mineral properties and plant facilities near Bessemer City, N.C., Lithium Corp. of America is a leading producer and marketer of lithium chemicals and compounds, used principally in the glass, ceramic, pharmaceutical, air conditioning, aviation, rubber and metallurgical industries.

Lithium, in a joint venture with an American subsidiary of Salzdethfurth A. G. of West Germany, holds leases to approximately 55,000 acres of land in the vicinity of Promontory Point about 10 miles west of Ogden. The company holds rights to extract potassium, magnesium and sodium salts from the waters of Great Salt Lake and, to date, is well advanced in its investigations.

New Plates Printed In Wah Wah Study

Shifting of topographic overlays for Plates 1 and 2 of Special Studies 17 (Igneous Complex at Wah Wah Pass, Beaver County, Utah) occurred during the reproduction process. Plates of the maps in question have been printed. Any purchaser may obtain these corrected plates of Special Studies 17 by writing to the Utah Geological and Mineralogical Survey, 103 Utah Geol. Survey Building, University of Utah, Salt Lake City, Utah.

1966 Mineral Production Up 1.8 Pct.

A gain of 1.8 percent in the estimated value of Utah's mineral production in 1966 hiked the state total to $439,200,000.

Production of seven nonmetal commodities grew in value; one (gem stones) remained unchanged, and eight others declined. However, the increase in phosphate rock and potassium salt production more than offset decreases in other nonmetal commodities.

While the value of both metal and nonmetal production jumped during 1966, it was the metal group that showed the more significant increase.

A breakdown of total production percentages follows:

—Metal group	65%
—Nonmetal group	11%
—Mineral fuels group	24%

Mineral fuel production value dropped partly because of a considerable decrease in gilsonite, natural gas and liquid petroleum gases. During the same period, production and values increased for carbon dioxide and natural gas over those of 1965.

Despite a drop in 1966 petroleum production, the industry accounted for 58 percent of the value of mineral fuels produced in Utah last year. Significant discoveries and increased production over late 1965 and early 1966 eased the decline.

During the same period, the recently discovered McElmo Mesa field was extended and South Ismay wells, No. 3 and No. 4, were drilled and completed by Monsanto Co. The firm reports flow was recorded at 2295 and 1118 barrels of oil a day, respectively.

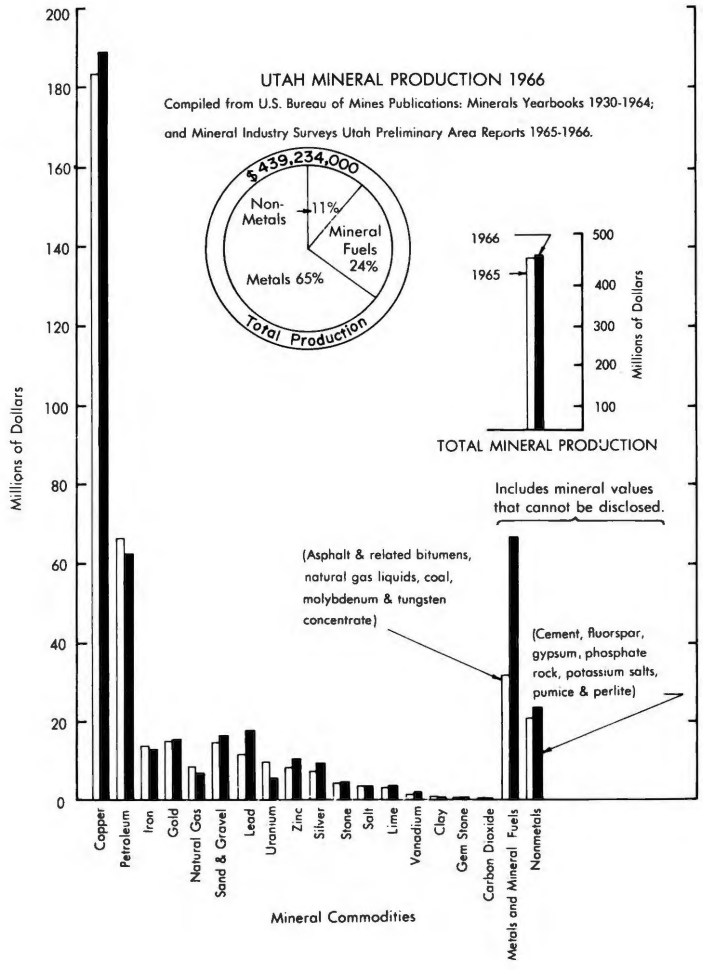
Coal production ranked second in mineral fuel production value.

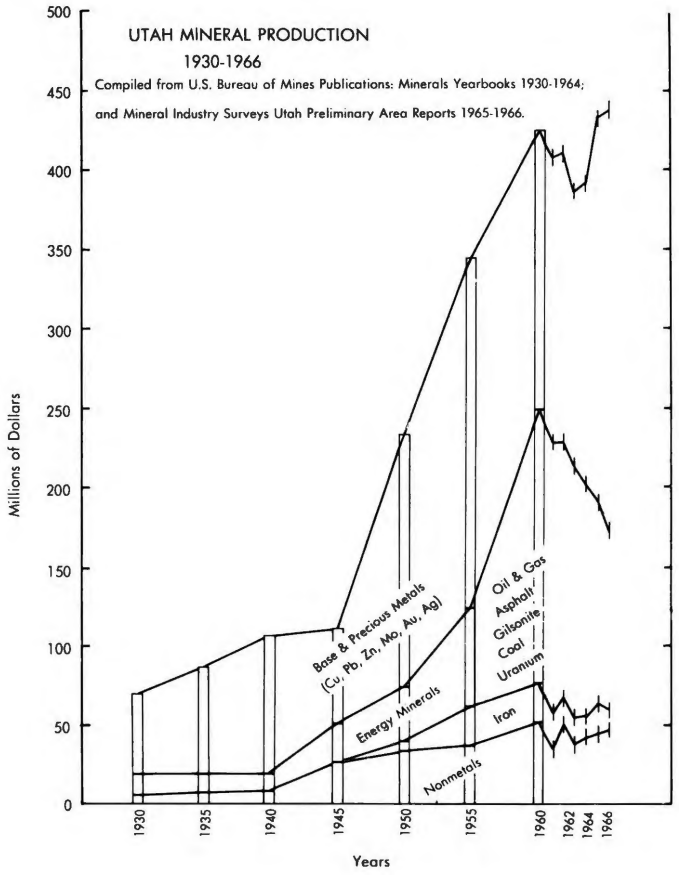
The mineral industry's contribution to Utah's economy is vital. Seventy percent of Utah's basic industries depend on the raw materials from minerals. Benefits from processing and manufacturing demonstrate the importance of the industry to our economy.

As of Jan. 1, Utah ranked third in the nation in uranium ore reserves.

Only New Mexico and Wyoming reserves exceeded those of the Beehive state, estimated at 1.5 million tons of uranium ore metallurgically amenable to treatment.

This report is based on an Atomic Energy Commission estimate, as well as, production during 1966.





New Wells Added To Sample Library

UTAH

Daggett County
Shamrock Oil & Gas Makin—
Federal #1
Sec. 21, T-3-N, R-25-E.

Duchesne County
G.S. Campbell et. al. Gov't. #31-1
Sec. 31, T-8-S, R-17-E.
G.S. Campbell et. al. Gov't. #31-2
Sec. 31, T-8-S, R-17-E.
Gulf Oil #1 Ute Tribal
Sec. 9, T-4-S, R-4-W.
Gulf Oil #2 Ute Tribal
Sec. 8, T-4-S, R-5-W.
Gulf Oil #1 Alkali Canyon
Sec. 31, T-6-S, R-4-W.
Gulf Oil #1 Nutlers Federal
Sec. 10, T-6-S, R-5-W.
Gulf Oil #1 Indian Canyon
Sec. 12, T-6-S, R-7-W.

Emery County
Shamrock Oil & Gas Witter—
Federal #1
Sec. 19, T-18-S, R-15-E.

Garfield County
Travis Oil Co. #1 Travis—Federal
Sec. 18, T-35-S, R-5-E. 0'-1950'

San Juan County
Bill Sticklin (Blue Danube) #1
Norma Federal
Sec. 33, T-39-S, R-18-E.
Texaco Inc. #30 Navajo "D"
Sec. 20, T-40-S, R-24-E.
Texaco Inc. #4 Navajo "H"
Sec. 1, T-40-S, R-26-E.
Texaco #1 Navajo "AE"
Sec. 19, T-34-S, R-21-E.
Texaco #1 Johns Canyon
Sec. 6, T-41-S, R-18-E.
Gulf Oil #3 Desert Creek
Sec. 11, T-41-N, R-22-E.

Summit County
Phillips Petroleum Co. #4
Bridger Lake Fork "A"
Sec. 26, T-3-N, R-14-E. 0'-5300'

Uintah County
Chevron Oil Co. #212 Red Wash
Sec. 8, T-8-S, R-24-E. 600'-10,040'
Gulf Oil #1 Gypsum Hills
Sec. 17, T-8-S, R-21-E.
Gulf Oil #2 Gypsum Hills
Sec. 8, T-8-S, R-21-E.

Wasatch County
Gulf Oil #1 Strawberry Ridge Unit
Sec. 18, T-5-S, R-11-W.

On Open File

Open File Miscellaneous Reports
- Report on Water Supplies for Bryce Canyon Lodge, June, 1925
- Flagstaff Formation Map (Weiss) (Drafting Office)

Open File Federal Projects
- Regional Gravity Survey of Moab-Nevada, etc.
- Principal facts for gravity stations, etc.
- Lists of Aeromagnetic and Radioactive Maps—Published and open filed by USGS.
- Analyses of some upper Paleozoic black shale sandstone and associated rocks.
- Airborne Geophysical Map Covering Wilderness Area — Hayden Peak and vicinity. (Drafting Office)
- Complete Bouguer Gravity Anomaly Map of the San Francisco Mountains Vicinity, Beaver, Millard Counties and Principal facts for gravity stations in the San Francisco Mountain Vicinity. (Drafting Office)

Open File Utah Survey Projects
- PR Spring-Roan Cliffs, Grand County and South Uintah Counties
- Geology of the Bituminous Sandstone Deposits-Asphalt Ridge
- Preliminary Report of Gypsum Deposits, Garfield County, Utah
- Mount Penell Copper Deposit, Garfield
- Salt Flat Sample Locations
- Great Salt Lake Sample Sites
- Reconnaissance of Bituminous Sandstone Deposits Trans-Dirty Devil. Wayne and Garfield Counties, Utah — by H. H. Doelling

DR. CALLAGHAN IN NEW POST

Dr. Eugene Callaghan, senior geologist in charge of mineralogical investigation, has been named assistant director of the Utah Geological and Mineralogical Survey.

Dr. Callaghan recently received other honors, when appointed to both the Council and the Nominating Committee of the Society of Economic Geologists.

He succeeds Frederick S. Turneaure, University of Michigan, on the SEG Nominating Committee and Felix Mendelsohn, Queen's University, Ontario, Canada, on the Council.

Dr. Callaghan has been a member of the UG&MS staff since Nov., 1965.

MECHANICAL LOGS

372 logs donated by Phillips Petroleum Co.

2,000 logs donated by Chevron Oil Co.

16 logs donated by the Oil & Gas Commission

2 logs donated by Texaco Inc.

2 logs donated by Gulf Oil

1 log donated by Zoller & Danneberg

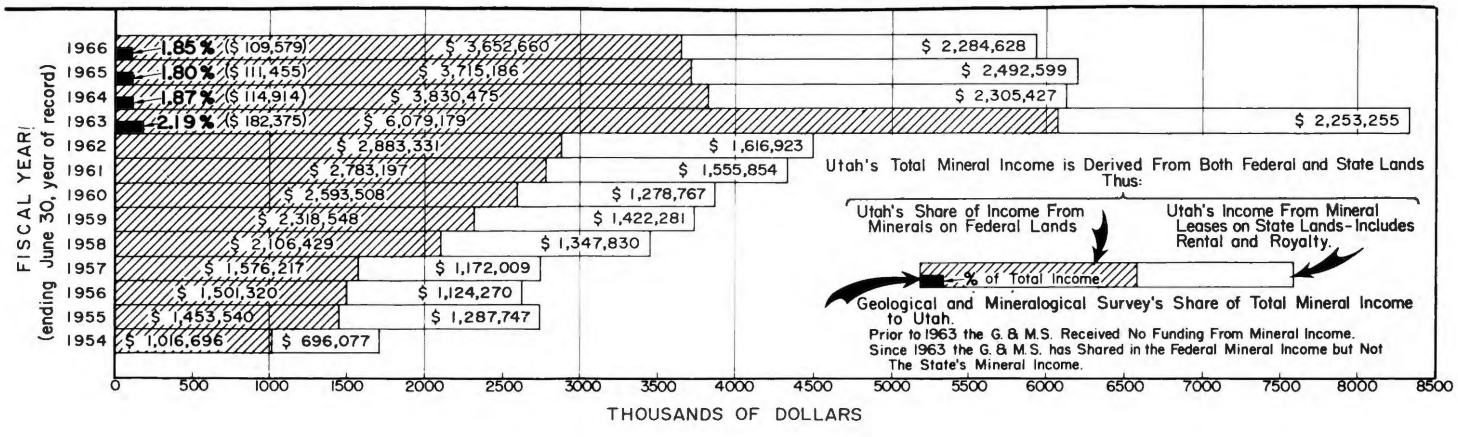
2 logs donated by Sinclair Oil & Gas

1 log donated by Helbing & Podpechan

2 logs donated by Superior Oil Co.

1 log donated by Continental Oil Co.

1 log donated by Monsanto Co.



Uranium Data In U. Library

Atomic Energy Commission reports of uranium from reconnaissance activities in 42 states now are available for public inspection in the University of Utah Library.

The reports briefly describe localities examined for reported anomalous radioactivity by U.S. Government geologists and engineers during the period 1950-1958.

In addition, data includes:

—Location;
—Ownership of property at time of inspection;
—Type of examination;
—Pertinent surface geologic and radiometric features;
—Radioactivity of samples collected;
—Reference to other published information on the area.

The original reports, processed on microfilm, contain an average of 30 reports which may be copied. A mechanical viewer is used to examine the film.

Increased demand for uranium concentrate adds value to the cards which may prove useful to those exploring for uranium ores.

States for which data are available include:

Alabama	Nevada
Alaska	New Jersey
Arizona	New Mexico
Arkansas	New York
California	North Carolina
Colorado	North Dakota
Connecticut	Ohio
Georgia	Oklahoma
Idaho	Oregon
Illinois	Pennsylvania
Kansas	South Carolina
Kentucky	South Dakota
Maine	Tennessee
Maryland	Texas
Massachusetts	Utah
Michigan	Vermont
Minnesota	Virginia
Mississippi	Washington
Missouri	West Virginia
Montana	Wisconsin
Nebraska	Wyoming

WEISS FLAGSTAFF MAP

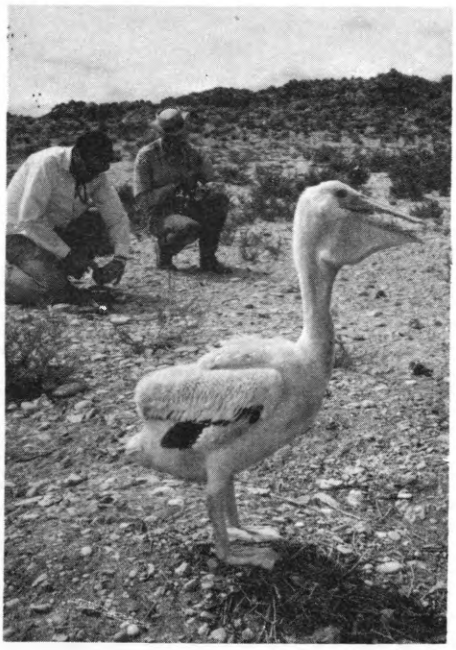
Malcolm P. Weiss' geologic map of Flagstaff and related formations is on open file at the Survey offices. This map also has been printed by Dr. Weiss and copies are available for $1.00 a sheet either through his office, Ohio State University, Department of Geology, 125 South Oval Drive, Columbus, Ohio 43210, or by order through the Utah Survey.

Gunnison's For the Birds . . .

Above:

Ornithologist Dr. William H. Behle of the University of Utah (upper right) and UGS crewman Farrell Woolford stand atop Stansbury's "Crows' Nest" — highest point on Gunnison Island. The rock cairn, which has an inside diameter of approximately 12 feet was built and used by the Stansbury expedition 118 years ago to hold surveying instruments. All rocks used in the "Crows' Nest" are of angular Bonneville tuffa, which is present near the top of the prominence. Below:

Rooked Rookie pelican, raging after being run out of the rookery, poses for his picture before being sacked on Gunnison Island beach.



By Robert E. Cohenour*

On July 8, 1966 units of the Great Salt Lake Research Fleet attacked Gunnison Island in the northern arm of the Great Salt Lake.

The landing party comprised of zoo keepers, television reporters and survey personnel quietly, methodically rounded up a portion of the feathered inhabitants and sacked a few of the rooked "rookie" pelicans destined for various zoological gardens.

Gunnison Island, which is protected and patroled by the Utah State Fish and Game Department, comprises approximately 155 acres and is 7.5 miles from the nearest prominent landmass. Presently much of its western reaches are bordered by relicted lake beds.

It is perhaps the only pelican rookery in the northern hemisphere and the annual pelican crop is estimated to be in the neighborhood of 1,500 birds. Isolation is needed for pelican development since both parents are busy fishing in Bear Lake or Utah Lake, in the waters artificially impounded in Bear River and Willard Bays. Because the nesting area is located in the sterile environment of Great Salt Lake each parent bird must make a 160-mile dinner flight twice a day and carry to its single offspring between four and eight pounds of fresh water food per flight. Fledging pelicans weigh nearly 20 pounds by the time they are capable of flying.

But Nature's aviary is not the island's only interest. Here, too, is one of Captain Stansbury's "crows' nests" some 85 feet above lake level. Approximately 12 feet in diameter on the inside, this rock cairn was built 117 years ago by members of this early expedition. Lt. Gunnison probably occupied this survey station during part of the 1849 survey.

Geologically the island is comprised of northerly dipping Paleozoic sediments, provisionally identified as carbonates of Silurian, Devonian and Mississippian in age.

More information regarding the lake, its islands and setting may be found on the NW Geologic Quadrant of the State and in Guidebook 20, "The Great Salt Lake," of the Utah Geological Society. Both are available at the Utah Survey.

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*Robert E. Cohenour, research geologist, terminated three years of Survey services Jan. 15 to resume work with the U. S. Atomic Energy Commission.

Prior to joining the UG&MS, Dr. Cohenour was employed by the AEC as a geological engineer in the western United States.

(Continued from page 4)

—The magnetotelluric method: the simultaneous measurement of the earth's magnetic and electrical fields.

In Utah, telluric current surveys have been used in experimental work to determine the thickness of the valley fill in Cedar and Skull Valleys. Resistivity surveys assisted in the determination of the depth to saturated ground water in the Salt Lake City area, and in the mapping of the "channels" associated with the emplacement of uranium mineralization on the Colorado Plateau.

SEISMIC METHODS

Seismic methods, using both refraction and reflection techniques, measure seismic wave velocity changes in rocks.

Despite the sophistication and success of such methods in the exploration for structures related to oil and natural gas, they have not been as extensively applied to metallic mineral exploration.

In 1954, concurrent with the planning of the causeway across the Great Salt Lake between Lakeside and Promontory Point for the Southern Pacific Railroad, a refraction seismic survey was made from boats along the proposed railroad line. Purpose of that survey was to chart the depth and lateral extent of the competent subsurface layer of Glauber's salt to be used in the foundation for the causeway's gravel fill.

In Utah, refraction seismic techniques also have been used:

—To assist in the mapping of the "channels" associated with uranium mineralization on the Colorado Plateau;

—To study the layering of the water-producing gravels in the Ogden area;

—To map the thickness of valley fill along an east-west profile between South Little Mountain and the Wasatch Fault in the north Ogden area.

RADIOACTIVE METHODS

One radioactive method — the use of a Geiger counter or scintillometer — has been successful in the uranium fields of Utah.

QUARTERLY REVIEW

State of Utah.....*Calvin L. Rampton Governor*

University of Utah.....*James C. Fletcher President*

College of Mines & Mineral Industries.....*George R. Hill Dean*

Utah Geological & Mineralogical Survey.....*William P. Hewitt Director*

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

103 Utah Geological Survey Building

University of Utah

Salt Lake City, Utah

84112

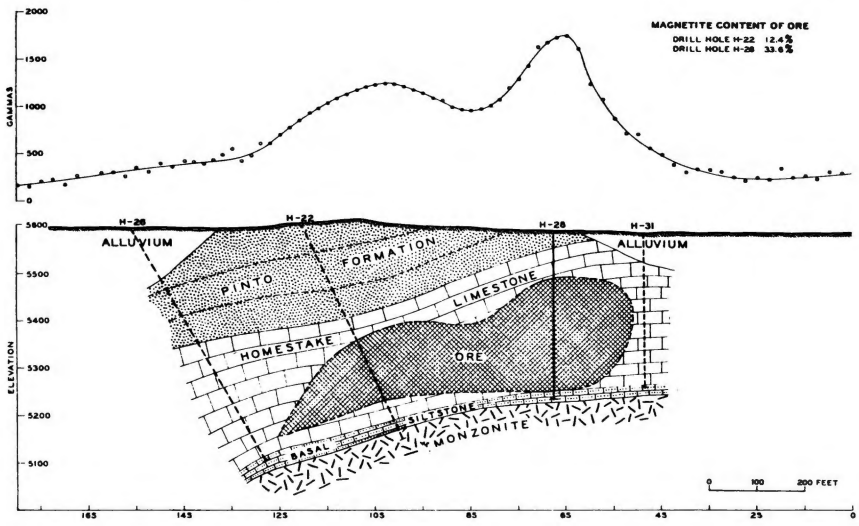

Figure 4. - Magnetic profile and geologic cross section along traverse 39.00 W, Thompson ore body, Desert Mound area, grid 19, showing discovery hole, H-22. (Topography and geology after W. E. Young and Geophysics by K. L. Cook.)

Uranium exploration activity has been stimulated of late by plans calling for peacetime uses of the ore in the generation of electricity.

Discovery and delineation of beryllium deposits in the vicinity of Spor Mountain are credited to the beryllometer, a nuclear beryllium detector device. Used to detect small traces of beryllium, this device is especially adapted to the logging of diamond drill cores.

REMOTE SENSING METHOD

The remote sensing method measures changes in the wave lengths of electromagnetic energy emitted from bodies at different temperatures.

The variation in emissions is detected by airborne electric and electro-optical remote sensors and recorded on photographic paper. "Hot spots" or "cold spots" can be detected in the photographs. The method, while relatively new, already has demonstrated that the course, or channels, of underground water sometimes can be detected, and the ponding of ground water can indicate a barrier, such as a fault. The method is being tested to evaluate its potential worth in the search for ore deposits.

COMBINATION OF GEOPHYSICAL METHODS

Most exploration programs in Utah today employ more than one geophysical method. Moreover, the geophysical surveys are but one part of the overall exploration effort, which commences with the best geological knowledge of the region and, perhaps, includes geochemical data, also. For example, the region may first be covered with a gravity survey for picking out areas of shallow valley fill. Next, an airborne survey including magnetometer, electromagnetic and scintillometer measurements taken simultaneously, may be made. Then this work may be followed with ground magnetic and electrical work. Finally, favorable targets will be test drilled.

THE FUTURE

Exploration geophysics in Utah is accelerating rapidly and probably will continue to do so.

A large percentage of the state is covered with alluvium-filled valleys. It is probable that many undiscovered ore bodies lie at shallow depths beneath this alluvium.

Each geophysical method described above probably will be used in future exploration in Utah for metallic and nonmetallic minerals or ground water.

Some of the methods will be used for the direct discovery of the minerals or ground water. Others will be used for the discovery or delineation of geologic structures or environments favorable to the existence of minerals or ground water.

Several major mining companies now have geophysics staffs headquartered in the Utah area, and modern geophysical laboratories either completed or planned. More and more, these companies are utilizing new computer techniques in the compilation and interpretation of geophysical data.