# NDGS NEWSLETTER

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COVER PHOTO

The photo on the cover shows a small area of collapsed materials above a burned-out lignite seam. The burning of coal beds results in slumping and caving of the layers above the coal bed. The cracks that form in the beds above the coal allow air to reach the burning lignite, helping to prolong the duration and extent of burning. The burning of buried coal veins throughout southwestern North Dakota has baked nearby sediments to natural brick, the reddish material generally known locally as "scoria."

CONTENTS

OIL & GAS ACTIVITY DURING 1984

For the past several years we have included a summary of the previous year's oil and gas activity, including new-pool discovery wells, in the June Newsletter. Several people have asked me to continue to include this information. So, even though the data used in compiling this summary is preliminary, I'll include it in this Newsletter.

First, some of the more obvious statistics (all of these figures must be considered to be unofficial as the NDGS does not compile official oil and gas statistics for North Dakota): oil production in North Dakota during 1984 totaled 52.6 million barrels, up from the 50.7 million barrels in 1983, which had been the previous annual record high figure. Production during the first four months of 1985 is running very slightly behind that recorded during the same period last year (17 million barrels, compared to 17.2 million barrels in 1984).

Our unofficial figures indicate that a total of 665 wells were drilled for oil and gas in North Dakota during 1984, up from the 481 wells drilled in 1983. Of these, 356 (54 percent of them) were listed as being capable of production. The 54 percent "success ratio" compares to 60 percent in 1983, 56 percent in 1982). A total of 30 new oil or gas pools were discovered during 1984 (table 1); currently (as of April), 25 of these are still producing oil or gas. Since a total of 171 wildcat wells were drilled in 1984, the exploratory success ratio was about 17 percent. That compares to exploratory success ratios of 26 percent in 1983 and 30 percent in 1982. Producing wells were drilled in 14 counties and new pool discoveries were recorded in 10 counties. Currently (end of June), about 40 drilling rigs are operating in North Dakota compared to the 55 rigs operating last year at this time.

Table 1.--Oil and gas discoveries in North Dakota during 1984.

| County, File No., Order No. | Comp. Date | Operator, Well, Location | Field, Pool (Number of Wells Currently in Pool) | Spacing | Total Depth | Interval Perforated | Initial Prod. (Current Daily Production) (Bbls. Oil) | Gravity | GOR | Water |
|---|---|---|---|---|---|---|---|---|---|---|
| Bottineau 10649 3690 | 05-17-84 | Kennedy & Mitchell, Inc. Magnuson Turtle Mountain #55-752-1 SENW Sec. 11-163-77 | Red Rock-Spearfish (1) | 40 | 3,300 | 3,002- 3,031 | 18 (7) | 35° | --- | 48 bbls. |
| Bottineau 10811 3661 | 06-14-84 | M & J Oil Company Helen Sidener 43-1 NESE Sec. 1-160-83 | Mountrose-Madison (5) | 40 | 4,496 | 4,332- 4,334 | 15 (-) | 29° | 100 | 28 bbls. |
| Burke 10556 3541 | 01-20-84 | Monsanto Oil Company Kinson-Carlson #1 NWSW Sec. 12-159-90 | Niobe-Madison (3) | Undesig. | 7,200 | 6,921- 6,942 | 180 (24) | 27.4° | 967 | 7 bbls. |
| Burke 10567 3601 | 02-20-84 | Monsanto Oil Company Kinson-Eckert #1 SESE Sec. 1-159-91 | Thompson Lake-Madison (1) | Undesig. | 7,526 | 7,256- 7,277 | 69 (12) | 30.7° | .2884 | 76 bbls. |
| Burke 10683 3521 | 04-21-84 | Chandler & Assoc., Inc. Haxton #2-33 NWNE Sec. 33-162-90 | Dale-Madison (6) | 80 | 6,270 | 6,086- 6,098 | 14 (9) | 38° | 930 | 13 bbls. |
| Burke 11039 3795 | 09-11-84 | Century Oil & Gas Corp. Opseth #29-7 SWNE Sec. 29-161-90 | South Coteau-Madison (4) | 160 | 6,875 | 6,540- 6,557 | 287 (52) | 32.5° | 1,167 | --- |
| Burke 11168 3898 | 10-29-84 | Albritton Resources, Inc. Dalin #25-1 SWSW Sec. 25-163-93 | Stampede-Madison (1) | 80 | 6,580 | 6,254- 6,284 | 33 (-) | 33° | 1,500 | 298 bbls. |
| Divide 10401 3510 | 01-01-84 | Solar Petroleum, Inc. Johnson #1 SESW Sec. 8-161-99 | Musta-Duperow (1) | 320 | 11,771KB | 9,208- 9,216 | 38 (65) | 41.5° | 501.6 | 5 |
| Divide 10402 3652 | 01-28-84 | Donald C. Slawson Glasoe #1-36 NWSW Sec. 36-161-96 | Upland-Gunton (1) | 60 | 12,251 | 12,010-12,034 | 55 (36) | 56° | 3,182 | 17 |
| Divide 10607 3575 | 03-12-84 | TXP Operating Company TXPOC-Norris #1-25 SESE Sec. 25-162-102 | Clinton-Red River (1) | (-) | 11,230 | 11,012-11,051 | 1,288 (11) | 51° | 264 | --- |
| Divide 10818 3751 | 07-02-84 | Conoco, Inc. Halvorson #31 5 NWNE Sec. 31-163-100 | Gooseneck-Duperow (3) | 320 | 11,160 | 8,612- 8,626 | 200 (183) | 37.5° | --- | 20 bbls. |
| Divide 10927 3850 | 10-03-84 | The Louisiana Land & Exploration Company State #1-43-6 SESE Sec. 6-163-100 | Colgan-Duperow (1) | 160 | 10,908 | 8,304- 8,308 | 76 (19) | 33° | 632 | 8 bbls. |
| Dunn 10735 3836 | 09-18-84 | Amoco Production Co. William C. Lubke #1A SWNW Sec. 11-146-96 | Rattlesnake Point-Red River (1) | 320 | 14,369 | 14,052-14,155 | 92 (42) | 49.9° | 3,326 | 29 bbls. |
| McKenzie 9480 3634 | 03-19-84 | Pogo Production Company Bratcher-Forthun #5-R SWSW Sec. 5-151-100 | Sakakawea-Madison (2) | 160 | 9,876 | 9,554- 9,570 | 46.5 (24) | 40° | 2980 | 28.6 |
| McKenzie 10658 3713 | 06-16-84 | The Superior Oil Company Nelson 2-2 SWSE Sec. 1-152-102 | Indian Hill-Duperow (3) | 320 | 13,800 | 11,453-11,486 | 203 (134) | 48° | 473 | 29 |
| McKenzie 10988 3816 | 10-26-84 | Texaco Inc. Texaco et al State of N.D. "D" 1 NWSE Sec. 10-150-96 | Johnson Corner-Stony Mountain (1) | 320 | 14,170 | 13,704-13,713 | 362 (42) | 45.7° | 2,555 | 186 bbls. |
| McKenzie 11125 3859 | 11-08-84 | Aminoil USA, Inc. State Rogness 1-43-16 SWSE Sec. 16-148-100 | Bully-Red River (1) | 320 | 14,089 | 13,944-13,954 | --- (-) | 58° | 13,587 | --- |
| McKenzie 10951 3871 | 11-11-84 | Milestone Petroleum, Inc. Federal #22-28 SENW Sec. 28-147-102 | Hay Draw-Red River (1) | 320 | 13,420 | 13,227-13,306 | 126 (92) | 46.5° | 1.3 MCFPB | 204 bbls. |
| McKenzie 10948 3870 | 11-27-84 | Milestone Petroleum, Inc. BN #21-7 NENW Sec. 7-146-102 | Pierre Creek-Bakken (1) | 320 | 13,330 | 10,738-10,758 | 157 (118) | 42.8° | 930 CFPB | .75 bbls. |
| Mountrail 10546 3570 | 02-01-84 | Monsanto Oil Company Esther #1 SWNW Sec. 17-158-88 | Coulee-Madison (1) | Undesig. | 7,151 | | 100 (-) | 25.2° | .13 | 154 bbls. |
| Renville 10974 3841 | 08-30-84 | Petroleum, Inc. F.L.B. St. Paul "H" 1 NENE Sec. 22-158-86 | White Ash-Madison (1) | 80 | 5,920 | 5,804- 5,808 | 25 (21) | 26.8° | 1 | 2 bbls. |
| Stark 10891 3544 | 06-22-84 | HNG Oil Company Zalesky 18 1A SWNE Sec. 18-140-98 | North Creek-Tyler (1) | 160 | 8,329 | 8,178- 8,190 | 79 (8) | 35.9° | --- | 33 bbls. |
| Ward 10505 3576 | 02-02-84 | Shell Western E&P Inc. Everson #43-20 NESE Sec. 20-155-86 | Mandan-Madison (1) | 40 | 7,300 | 6,720- 6,740 | 55 (32) | 30.6° | 327 | 25 bbls. |
| Williams 10646 3695 | 05-31-84 | Atlantic Richfield Co. Irgens #1-27 NESW Sec. 27-156-100 | East Fork-Madison (6) | 160 | 13,710 | 9,206- 9,226 | 662 (116) | 31.6° | 430 | 27 bbls. |
| Williams 10493 3563 | 06-01-84 | Universal Resources Corp. Kerbaugh State #1-32 SWSW Sec. 32-156-96 | Dollar Joe-Silurian (1) | 320 | 13,300 | 12,636-12,721 | 29 (-) | 47.6° | 2,034 | 49 bbls. |
| Williams 10886 3719 | 06-25-84 | Sage Energy Company L. Green #41-17 NENE Sec. 17-152-103 | Sugar Beet-Madison (1) | 160 | 9,150 | 8,940- 8,950 | 30 (10) | 38.6° | --- | 150 bbls. |
| Williams 10653 3720 | 07-02-84 | Atlantic Richfield Co. ARCO Reider #1-11 NWNW Sec. 11-155-101 | Cow Creek-Madison (1) | 320 | 13,700 | 9,220- 9,231 | 87 (40) | 36.2° | --- | 169 bbls. |
| Williams 10681 3747 | 07-29-84 | Gulf Oil Corp. Skurdal #2-24-1B NENW Sec. 24-153-102 | Hardscrabble-Madison (1) | 320 | 13,378 | 9,104- 9,119 | 339 (223) | 36.5° | 635 | 74 bbls. |
| Williams 10893 3771 | 08-27-84 | Atlantic Richfield Co. ARCO Eidsvoog #1 CNE Sec. 1-157-100 | Dublin-Madison (2) | 320 | 13,348 | 8,831- 8,840 | 114 (107) | 30.6° | --- | 4.46 bbls. |
| Williams 10707 3765 | 09-12-84 | Gulf Oil Corp. Nasner #1-30-1A NWNW Sec. 30-156-101 | Tyrone-Stonewall (1) | 320 | 13,555 | 13,050-13,062 | 130 (57) | 44.5° | 1,189 | 3 bbls. |

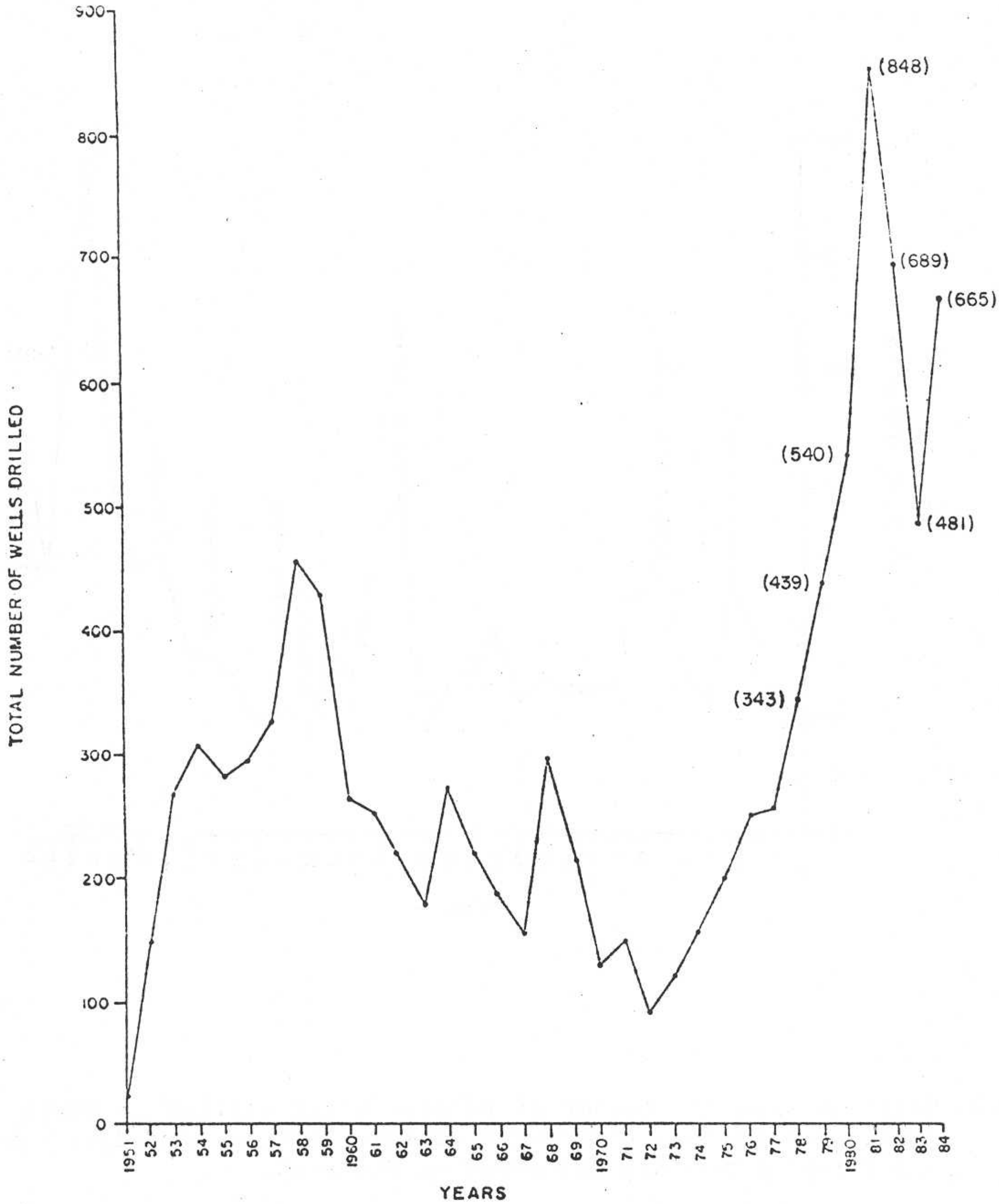



Figure 1. Graph showing the number of wells drilled in North Dakota each year since oil was discovered in 1951. The totals include both exploratory and development wells.

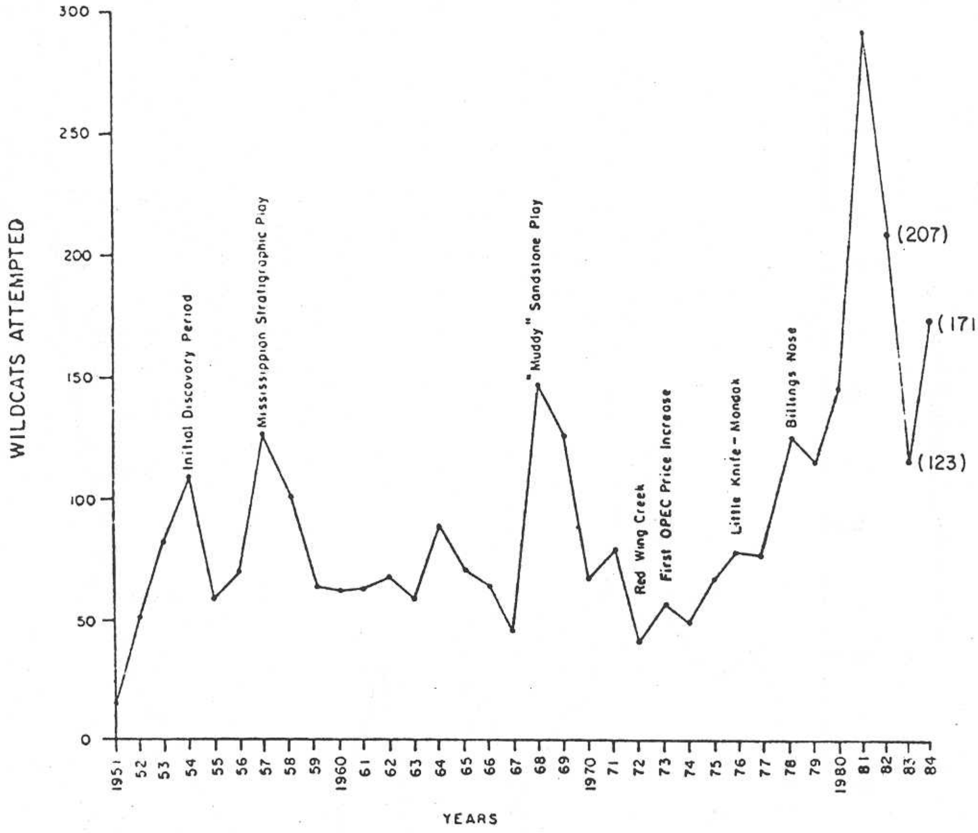



Figure 2. Graph showing the number of wildcat wells drilled in North Dakota each year since oil was discovered in 1951. Some of the major events affecting drilling activity are noted on the graph.

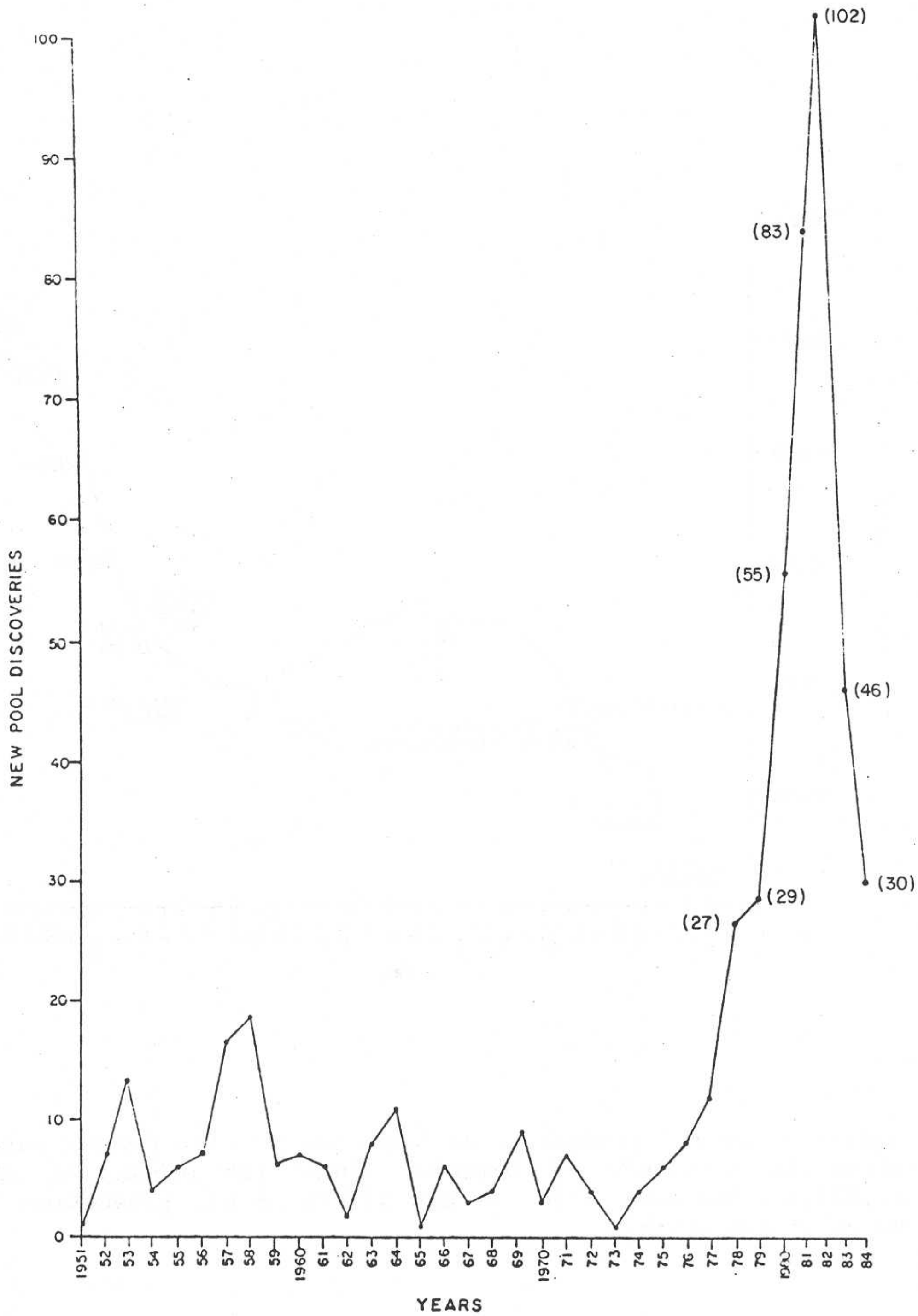



Figure 3. Graph showing the number of new pools discovered each year in North Dakota.

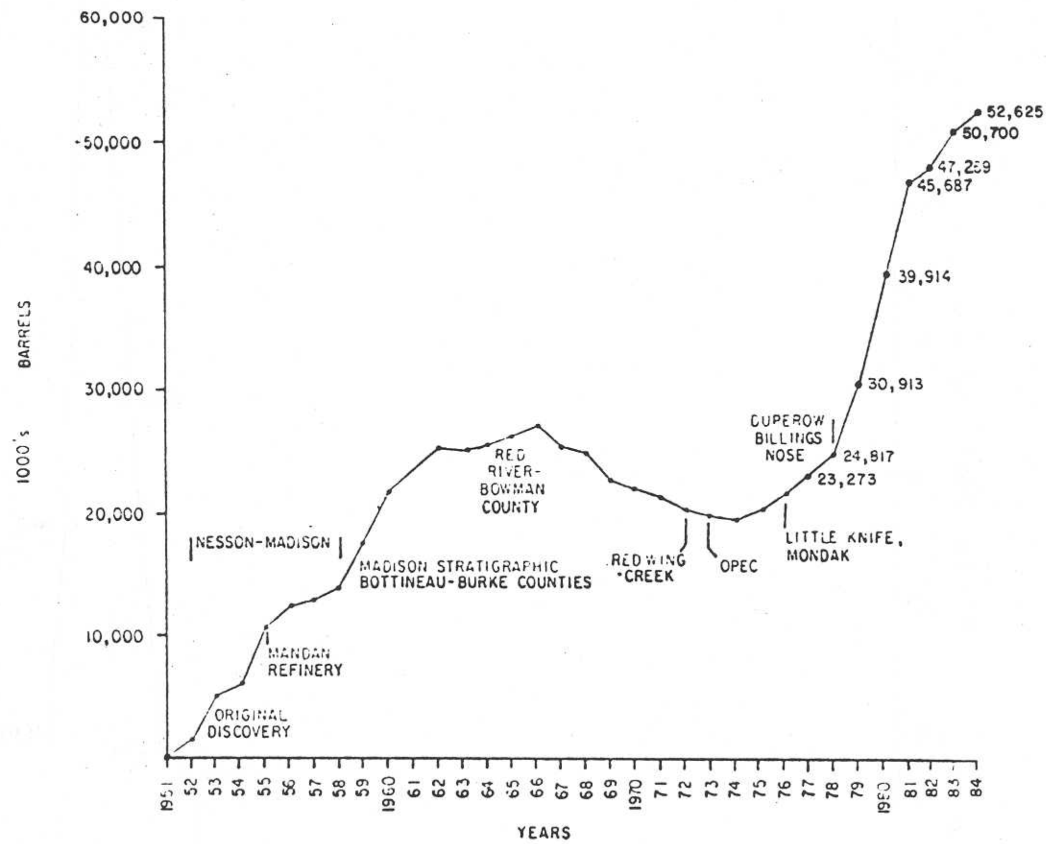



Figure 4. Annual crude oil production in North Dakota. The figures since 1977 are given in thousands of barrels; thus, the production in 1984 was 52,625,000 barrels. Major events affecting oil production history are noted on the graph.

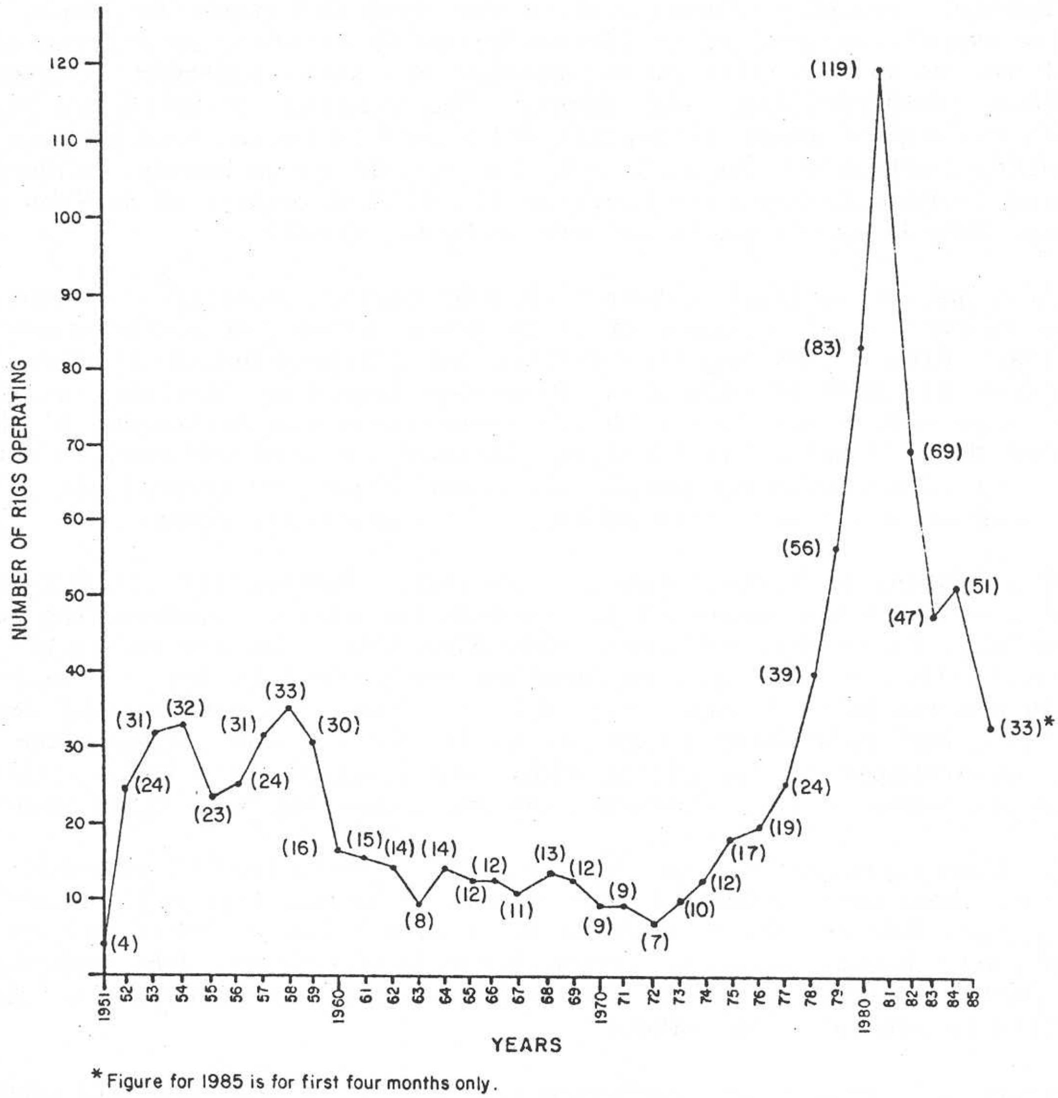



Figure 5. Average number of drilling rigs operating in North Dakota each year since 1950 (weekly average total divided by 52).

SURVEY RESEARCH ACTIVITIES --John Bluemle

At latest count, NDGS geologists and engineers were involved in about 40 separate research projects. The compilation here is broken down into several categories and is probably incomplete. Some of the projects involve research by University of North Dakota faculty and graduate students supported by the NDGS.

We are nearly finished with our detailed appraisals of the geology of all of North Dakota's counties. These studies have been underway since about 1960 and we have now mapped the geology of virtually the whole state at a scale of 1:125,000 (1 inch to two miles). Five county studies are still underway: Bottineau, McKenzie, Dunn, Ward/Renville, and Ramsey. The reports on Bottineau and McKenzie Counties are almost ready to publish and should be by the time we once again have publication funding available. During the current field season, Ed Murphy will be returning to Dunn County after working all of last summer on various groundwater projects. John Bluemle expects to work in Ramsey County.

Three paleontological studies of near-surface fossils are underway. These involve excavation and collection at important sites and preservation of certain significant sites. John Hoganson directs our paleontological studies. He expects to continue his work of excavating Oligocene mammal and mollusk fossils in Stark County, a project being done with the cooperation and assistance of the Manitoba Museum of Man and Nature in Winnipeg. Studies are also underway to determine the feasibility of establishing protected status (Nature Preserves, etc.) for various paleontological sites and other geologically significant sites.

We are studying certain specific geologic problems and situations that have potential to cause environmental damage with the goal of recommending solutions to the problems. Ed Murphy, with help from Alan Kehew, is continuing his studies of the effects that oil and gas exploration and production have on shallow groundwater in western North Dakota. This includes study of the effects of reserve pits, brine pits, and salt-water injection wells. Ed is also studying the effects on shallow groundwater of reclaiming abandoned lignite strip mines. Alan Kehew is working on possible contamination problems caused by municipal sewage lagoons.

Two investigations are underway on various paleoclimatic problems. We hope to learn more about North Dakota's paleoclimatic history, especially since the end of the ice age. Bob Seidel is working on a paleoclimatic investigation of southwestern North Dakota using deflation basin stratigraphy. John Hoganson has been using fossil insects as proxy indicators of past environments at the McClusky Canal Site in central North Dakota.

Survey geologists have undertaken a number of oil and gas production and engineering studies concerning oil production, reservoir characteristics, and other factors relating to oil production in North Dakota. A partial listing of studies includes one by Sid Anderson and Marv Rygh on hydrocarbon migration in the Madison Group in Bottineau and Renville Counties; a scanning-electron microscope study by Dave Brekke of the pore geometry and pore mineralogy of cores from the Mission Canyon Formation; an overview by Dave Fischer, along with Dick and Cheryl Pilatske (Dick is with Coastal Oil & Gas and Cheryl is with Southport Exploration, both in Denver) of Devonian Duperow Formation oil production in the Williston Basin; a study by Dave Fischer and Will Gosnold (Will is a UND geology professor) of the relationship between the earth's heat flow and oil production in the Billings Nose area of western North Dakota; a study by Dave Fischer, Lee Gerhard, and Erling Brostuen to determine the relationship between deep Red River Formation oil production and shallower shows of hydrocarbons; and a study by Randy Burke and Lee Gerhard comparing Madison Group oil reservoirs in North Dakota with the oil-producing Yates Formation in west Texas.

Detailed studies are underway on the subsurface geology, environments of deposition, depositional history, distribution, and other properties of various subsurface rocks in North Dakota. These include a study by Julie LeFever and Sid Anderson of the Nesson Anticline stratigraphy, structure, and petroleum engineering characteristics; a study by Julie, Sid, and Rich LeFever of selected Spearfish Formation sands, examining distribution, depositional and diagenetic history, and the potential for oil occurrence; a study by Julie LeFever of the Madison Mission Canyon and Charles Formations in portions of Renville, Ward, and Bottineau Counties detailing the structural and depositional history of the area; a study of the Mondak Field, by Dave Fischer and Mike Hendricks (a private consultant in Denver), with the goal of detailing the Madison Group reservoir and its geology, depositional history, depositional environment, and oil production; a study by Randy Burke of the Duperow Formation in Billings County, including diagenesis, reservoir properties, facies distribution, and oil production; and a study by Dave Brekke detailing the geochemistry, log characteristics, and distribution of potash in North Dakota.

A variety of geologic problems are being studied in an attempt to better understand the State's geologic history, landforms, and economic geology. We now have three 1° x 1° mapping projects in progress, one in the southeastern part of the state, one in the extreme east, and one in the west-central part. This project is being coordinated by Ken Harris, who is also responsible for the studies underway in the eastern part of the state. Ed Murphy is working on the west-central area. Other projects underway include a study of the origin of glacial-lake spillways throughout the state (Alan Kehew); a study of the geology of the glacial Lake Souris area (Mark Lord, a UND graduate student); a study of certain subglacially molded surfaces and ice-thrust features in west-central North Dakota (John Bluemle); a study of the sedimentology and geomorphology of anomalous hills in southeast North Dakota (Ken Harris); and a study of the preglacial drainage and of the interglacial and post-glacial drainage evolution in North Dakota. We are cooperating with the USGS on a new Decade of North American Geology (DNAG) volume on Quaternary Nonglacial Geology of the Conterminous United States.

In addition to these research projects, we continue to work on a variety of educational activities. We are compiling a non-technical book on the geology of North Dakota (John Bluemle). By the end of the summer, we hope to have small packets available containing a collection of rocks and minerals and maybe fossils that can be supplied to schools at nominal cost. We are updating our slide program of North Dakota geology and we hope to have this available soon.

Rod Stoa has been cutting samples of core, at least one sample from each formation represented in North Dakota, so that we will have a sort of reference set of the Williston Basin rocks. We may also construct a stratigraphic column in our museum, using actual rock samples. Rod plans to prepare representative samples of core from a variety of lithologies within some of the more important and varied rock units, such as the Mississippian Madison Group.

## BISMARCK CHOSEN FOR 1988 AAPG MEETING

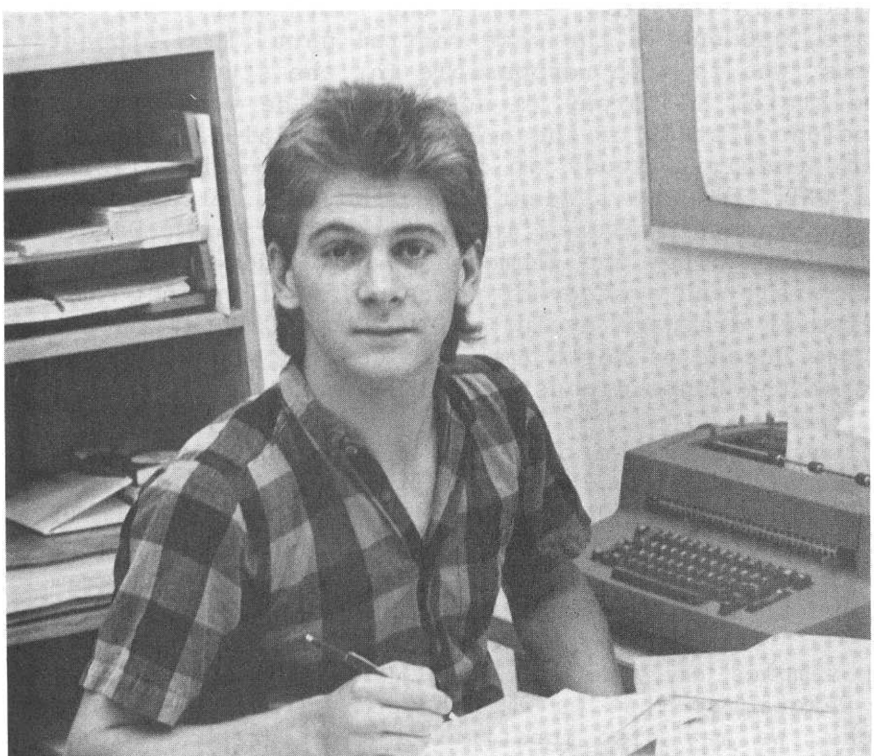
Bismarck-Mandan has been selected to host the Rocky Mountain Section meeting of the American Association of Petroleum Geologists in 1988. The AAPG meeting this year (June 2 to 5) was in Denver. Next year the meeting will be in Casper, Wyoming and in 1987 it will be in Boise, Idaho. Meetings in past years have generally been held in Denver, Billings, Albuquerque, Casper, or Salt Lake City. The 1988 meeting in Bismarck will be the first time the AAPG has met in North Dakota.

## NEW PUBLICATIONS

We were unable to release any new publications during the past six months because our publication budget had been spent. With the start of our new biennium on July 1, we have geologic reports on Bottineau and McKenzie Counties nearly ready for the printer. We hope to have these reports available by the end of the summer.

The North Dakota Industrial Commission recently released a report, "Oil in North Dakota--1982 Production Statistics." This report is now available from the Oil and Gas Division, 900 East Boulevard, Bismarck, North Dakota 58505. Cost is $15.00.

## CHANGES IN PERSONNEL



Our new publications clerk is Kent Hollands. Kent is a 1982 graduate of Fisher High School, Fisher, Minnesota and he attended the Area Vocational Technical Institute in East Grand Forks, Minnesota for two years. Prior to coming to the NDGS, Kent worked at Video City, an electronics store in Grand Forks.

Jana Diemert, who was our publications clerk for the past year, took a job with the Medical Center Rehabilitation Hospital.

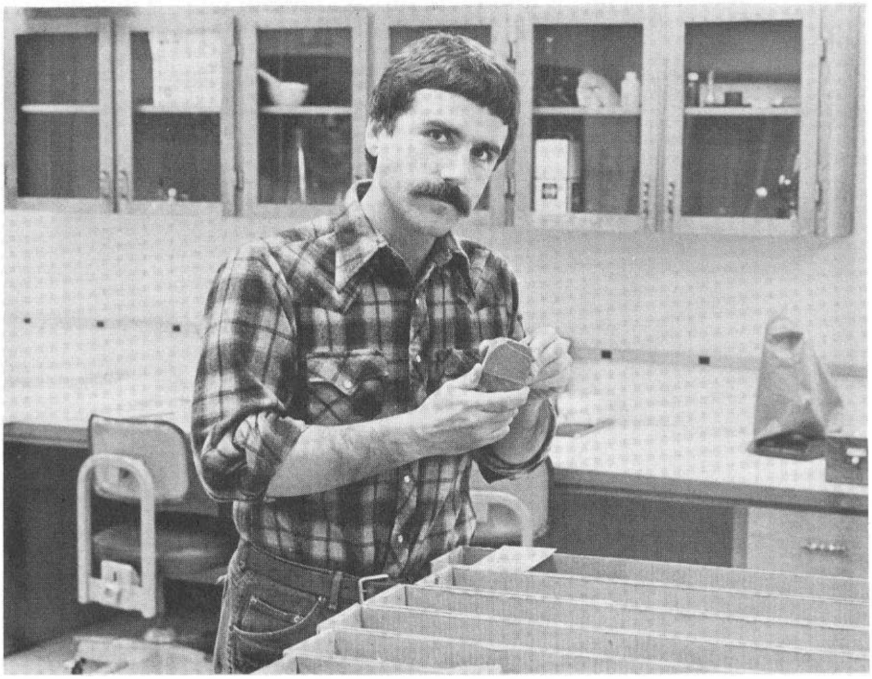
SURVEY PROFILES

David Fischer

David Fischer is a subsurface geologist working half-time for the NDGS. Since coming to the Survey in 1983, his research has been concerned with local and regional studies of the North Dakota portion of the Williston Basin. He has also been involved in monitoring current oil industry activity in the State. David's studies have led to an NDGS publication on some previously unknown Paleozoic salt deposits in western North Dakota and he also coauthored a paper on productive zones in the Devonian Duperow Formation. He has recently been involved in studies of Mondak Field, in a study of deep drilling in the State, and in a study of the thermal structure of the Billings Nose area.

David has a B.S. degree in Earth Science from North Dakota State University and an M.S. in Geology from the University of North Dakota. Prior to coming to the NDGS, he had experience as an exploration geologist with Gulf Oil, working out of Casper, Wyoming, and as a staff geologist with Supron Energy in Denver. Both of these positions called for oil exploration and development work in the North Dakota part of the Williston Basin.

When he is not working for the Survey, David acts as a private geologic consultant.



David Lechner

Dave Lechner, the Survey's technician since 1976, is responsible for operating our well-logging equipment. He is also our Radiation Safety Officer. His job consists mainly of operating our logging equipment, running gamma ray, self-potential, and resistivity logs. These logs are generally run when test holes are drilled to better determine the textures and rock types of the materials being tested, the exact thicknesses and depths of coal beds, and other information. Dave also operates our sedimentary laboratory, spending considerable time in the winter analyzing textures of samples that were collected during the previous field season. He also keeps the Survey's oil and gas field maps up to date.

Dave is from Ohio. He attended high school in Toledo and the University of Toledo, majoring in Arts and Sciences. He also served in the Navy, attending Navy Electronics School. Finally, he attended Ohio State University in Columbus for three years, majoring in horticulture, from 1969 until 1972. He has had experience as a salesman in electronics, and at various electronics-related jobs.

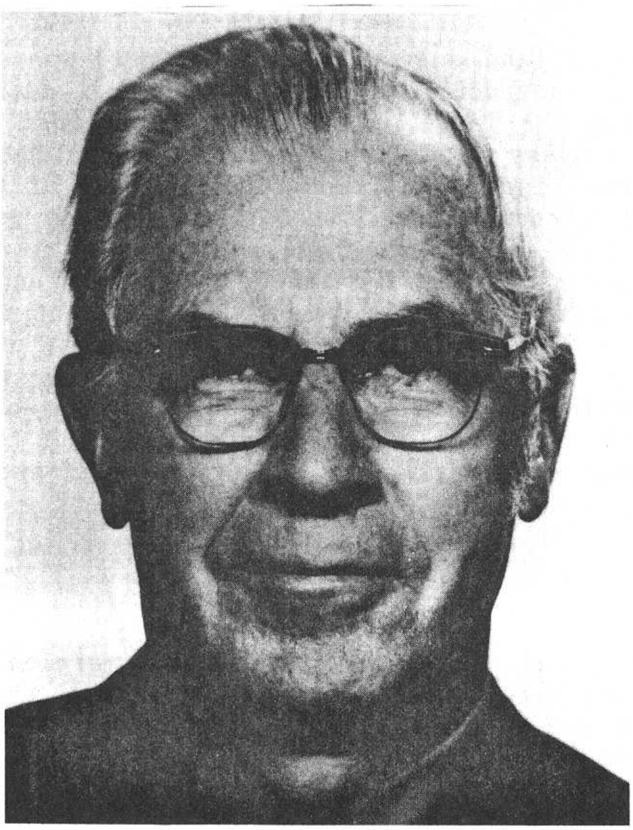
Dave is one of a trio of triplets; the other two of the trio live in Ohio. He is interested in a variety of activities, including gardening, cooking (and eating), antiques and old houses, fishing, the arts in general, and playing bridge, whenever he can find someone who knows how to play.

DR. FRANK FOLEY DIES

Dr. Frank C. Foley, State Geologist of North Dakota from 1938 to 1941, died March 26, 1985 in Topeka, Kansas at the age of 78 years. Dr. Foley was born August 8, 1906, in Belleville, Ontario. He received his bachelor's degree from the University of Toronto in 1929 and his doctorate from Princeton in 1983. He taught geology at Dartmouth in 1929-30, at Princeton from 1930-33, and at the University of North Dakota from 1933 to 1941.

When Dr. Foley took over as State Geologist, he was the only person on the Survey staff and he was also expected to teach full-time for the UND Geology Department. From 1942 to 1945, Dr. Foley served with the U.S. Army Corps of Engineers in Morocco and Italy. He worked for the Wisconsin Geological Survey from 1946 to 1951 and for the Illinois Geological Survey from 1951 to 1954. He became State Geologist of Kansas in 1954 and Chairman of the Geology Department at Kansas University in 1957.

Dr. Foley published numerous papers on groundwater geology. He served as a consultant on water resources in Saudi Arabia, West Africa, and Uganda for the United Nations.



Dr. Frank C. Foley, State Geologist, 1940-1941. Geology Department, University of North Dakota.

## TERMINATION OF MINERAL INTEREST

--Dave Brekke

Recently the Survey has been contacted by mineral-interest owners requesting information about claiming their mineral interest. This activity was in response to a July 1, 1985 deadline for filing a statement of claim imposed by legislation passed in 1983. In this article I will attempt to explain the legislation codified as Chapter 38-18.1 of the North Dakota Century Code. Specific questions about the law should be directed to an attorney.

The 48th Legislative Assembly of the State of North Dakota passed legislation in 1983 providing for the termination of mineral interest owned by persons other than the owners of the surface if that mineral interest is abandoned. A mineral interest includes any interest in oil, gas, coal, clay, gravel, uranium, and any other mineral. A mineral interest is said to be abandoned if it is unused for twenty years. However, if the mineral interest owner files a statement of claim with the county register of deeds before the twenty-year period of non-use is over, the rights are retained. The rights are also retained if the mineral interest is used. The mineral interest is considered used if there is any activity of any kind such as production, injection, disposal, storage, or subject to a lease, mortgage, assignment, conveyance, pooling order, unitization, or payment of taxes on the mineral interest. Therefore, the mineral-interest owner has to file a statement of claim only when the interest has not been used in any way for twenty years.

If the surface owner (and only the surface owner) wants to claim the mineral interest after apparent abandonment, he must publish notices in the official county newspaper stating the lapse of the mineral interest. If the original mineral interest owners address is in the records or can be determined upon reasonable inquiry, he must also be notified. Then, if the original mineral interest owner chooses, he has 60 days after the notice is given to file a statement of claim and thus retain his rights. When the notices fail to generate any response from the mineral-interest owner and the interest has been unused for twenty years, the mineral interest rights are considered abandoned and revert to the surface owner or owners.

Although this Newsletter will be distributed after July 1, the twenty-year non-use clause is still in effect. As it stands now, mineral-interest owners will have to file a statement of claim every twenty years if the interest is not used within that time.

## STRIPPER WELLS

--Marv Rygh

Stripper wells are oil wells that produce a marginal amount of oil. The federal government classifies a stripper well as a well that produces less than ten barrels of oil per day. Most stripper wells are oil wells that may once have produced at a higher rate, but the production rate has, over the years, declined to its present level.

It is important to note that, even when individual well production is small, the cumulative production from these wells represents a significant amount of oil. For example, in 1983, the 442 thousand stripper wells in the United States produced a cumulative total of 462 million barrels of oil, or about 15 percent of the total national production for that year (fig. 1). This amounts to an average of nearly 3 barrels of oil per day for each well. Stripper wells might actually produce at a larger daily rate, but they are shut in periodically because of production reasons. North Dakota had 922 stripper wells in 1983; these wells produced 1.5 million barrels of oil, about 3 percent of our yearly oil production.

The number of stripper wells still producing and the amount of oil they produce is directly related to economics. Specifically, the price of oil, taxes, production costs, and royalties all affect the economic life of a well. The number of stripper wells in the United States has steadily increased over the past 3 years, indicating that increased incentives do result in prolonging the life of the wells and in increased oil production (fig. 2).

Stripper wells are given tax incentives by both the federal and state governments. For example, independent operators may receive an exemption from the federal Windfall Profits Tax and North Dakota's 6½ percent extraction tax is waived on all stripper wells in the state. In spite of the various incentives favoring stripper wells, the total number of pluggings and abandonments has increased in the past 3 years. Figure 3 shows that an increasing number of oil wells are reaching their economic limit and are being plugged. The number of abandonments depends mainly on the price of oil. Higher oil prices would help to delay the abandoning of stripper wells and ultimately result in the production of more oil.

Every time a well is plugged and abandoned, some oil is left in the ground. For practical purposes, this oil will never be recovered, a regrettable, but economically necessary circumstance. We should attempt to continue our stripper well production as long as possible. Oil is a nonrenewable resource and we should leave as little of it in the ground as possible when oil fields decline to the point of being unprofitable. The longer every stripper well can produce, the less oil we will leave in the ground, never to be recovered, and the less we have to rely on oil imported from foreign countries.

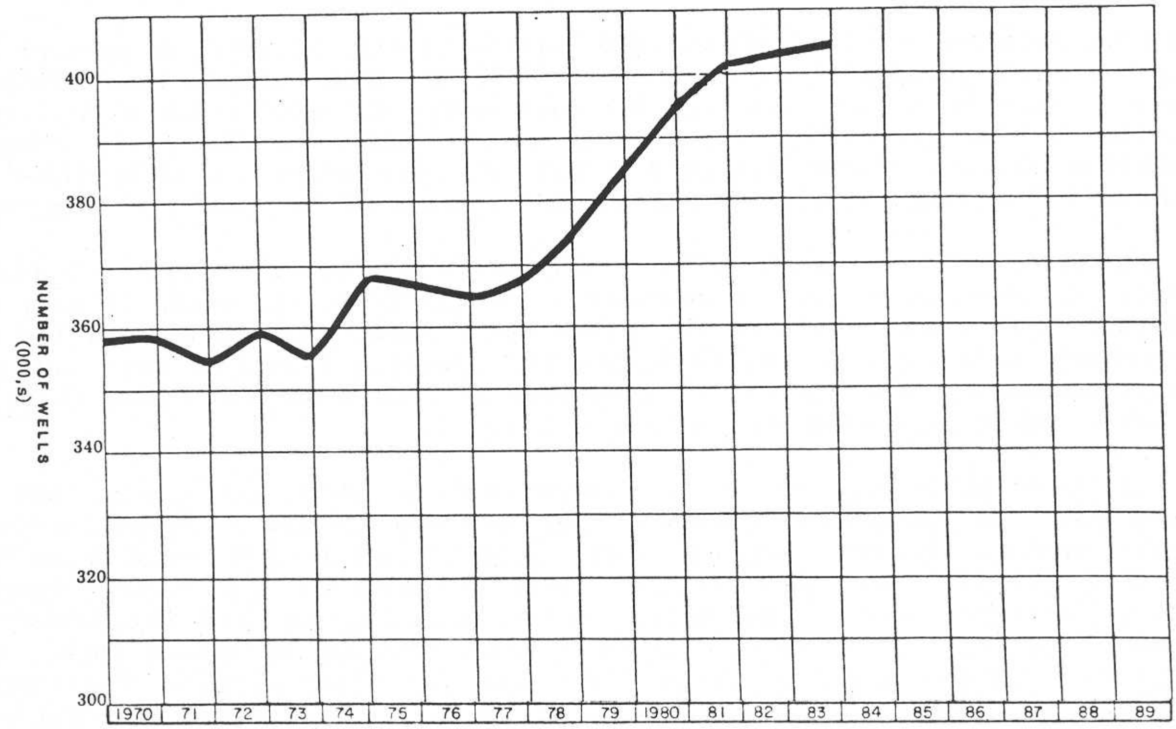



Figure 1. Number of U.S. stripper wells


Figure 2. Annual stripper well production

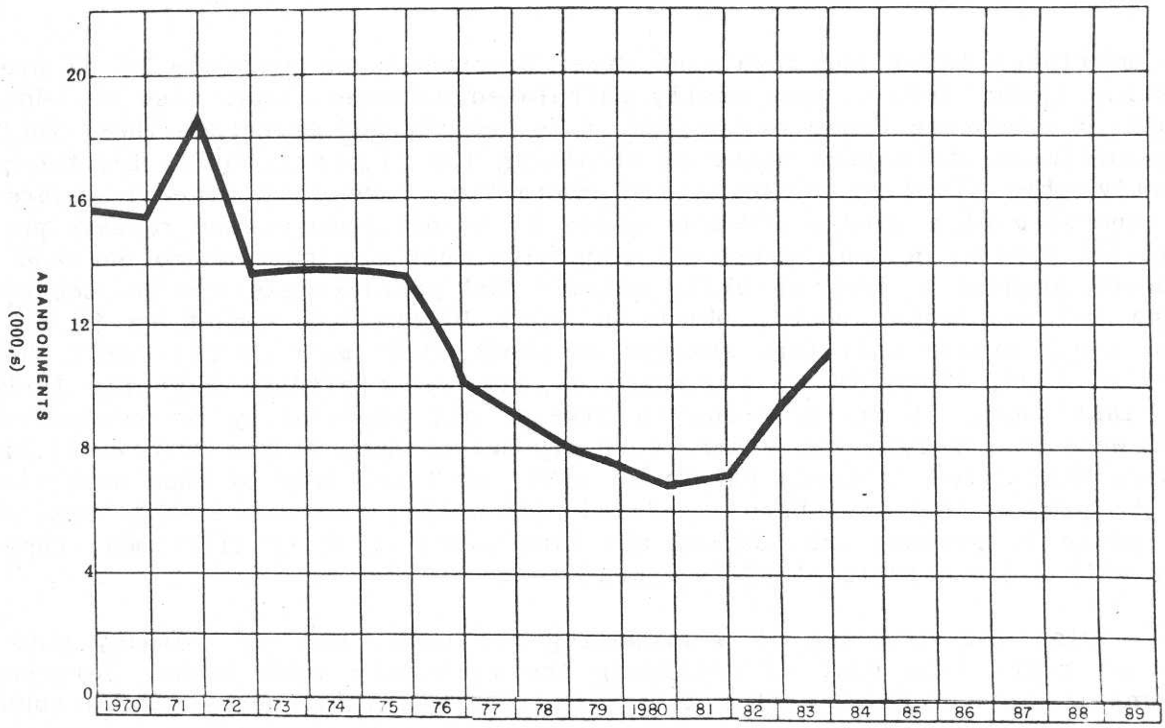



Figure 3. Total U.S. annual number of stripper well abandonments.

## OIL INDUSTRY PROFITS

--Sidney B. Anderson

Much has been written lately about high profits in the oil industry. Although large sums of money are involved in virtually all phases of operation in the industry, the profit margins are not necessarily as great as many people seem to believe.

A barrel of crude oil amounts to only 42 gallons and is sold on the world market for $28.65, about 68 cents a gallon. North Dakota crude oil is worth slightly less, currently between $25.00 and $26.50 a barrel. How much does it cost to produce that barrel of oil? It's not a simple matter to answer that question, but maybe we can put the costs into some perspective.

Oil royalties--the amount of money an oil company pays to the person who owns the mineral rights to the land from which the oil is produced--generally range from 1/8 (12.5%) to 1/6 (16.7%) of the oil produced. Thus, the mineral owner receives the first 5.2 to 7 barrels of every 42-gallon barrel of oil produced (the oil company buys the oil from the mineral owner for the going price). Next, the State of North Dakota levies a 5 percent severance tax and a 6.5 production tax (11.5% total). A federal windfall profit tax is added to this, but because of the currently declining price of crude oil and with a gradual phase-out, this tax in North Dakota amounts on only about a half a percent. Total taxes on a barrel of crude oil are therefore about 12 percent. This means that, when the royalty (either 12.5 or 16.7 percent) is added to the tax (12 percent), the oil company must pay a total of 24.5 or 28.7 percent of the value of the oil before it can do anything about refining or marketing it.

I mentioned taxes and royalties first because it is possible to be precise in listing these. Other, less easily calculated expenses, must also be added to the cost of producing crude oil before it is refined and marketed. These include: lease aquisition costs (the costs of obtaining the rights to drill for the oil--frequently this involves locating and contacting dozens of mineral owners who share ownership of a single 160-acre piece of land); bonuses and rentals paid to the mineral owner( in many cases oil companies must pay this money on land that will never produce a drop of oil); seismic and geologic exploration costs; and drilling and completion costs, which in North Dakota may amount to $1 to $1.5 million for a single well (the average is about $1.25 million per well). When a well is drilled, there is no assurance it will ever produce any oil. In North Dakota last year, 16 percent--one in six--of all exploratory or wildcat wells drilled were successful; the others were dry holes. And, of the 30 new oil fields that were discovered in North Dakota in 1984, at least four of them have already ceased to produce and have been abandoned. All wells, even successful ones, eventually cease to produce and, during the last years of their lifetimes, they may produce only a few barrels of oil a month.

Following the drilling of a producing oil well, the oil company must pay completion costs (the cost of equipping the well site with tanks, sometimes a pump, and other equipment. After this comes the operating costs, which continue throughout the life of the well, transportation costs (sometimes by truck, in other cases by pipelines, which must be constructed) before the oil arrives at the refinery. After the oil is refined (and the refining costs are added), the refined products have to be transported, either by truck or pipeline or both, to the dealer. Finally, the dealer sells gasoline to you after he has added 4 cents federal tax and 8 cents state tax. You may pay $1.25 a gallon for this gasoline.

It's also interesting to look at the products that are produced from a barrel of crude oil. A typical 42-gallon barrel of oil is currently refined to produce 9.5 gallons of leaded gasoline, 9.4 gallons of unleaded gasoline, 8.6 gallons of distillate fuel oil (diesel fuel, heating oil, etc.), 4.3 gallons of residual fuel oil (ship engine fuel, etc.), 3.2 gallons of jet fuel, and 7 gallons of petrochemicals (synthetic fibers, plastics, greases, etc.) (fig. 1). The amounts of these products can be adjusted, depending on current needs and the type of crude oil being processed. Thus, as winter draws near, refineries commonly increase the amount of fuel oil produced per barrel, at the expense of other products.

Considering all of the expenses I have just outlined, I think it is amazing that gasoline and other refined petroleum products do not cost much more. Certainly, the oil industry is in business to make a profit, and we have to presume that it does so. The profit margins, however, are not necessarily large and the oil companies must be extremely efficient to show any profit at all in view of the current price of crude oil and the many expenses that have to be met in the process of converting oil in the ground into finished products.

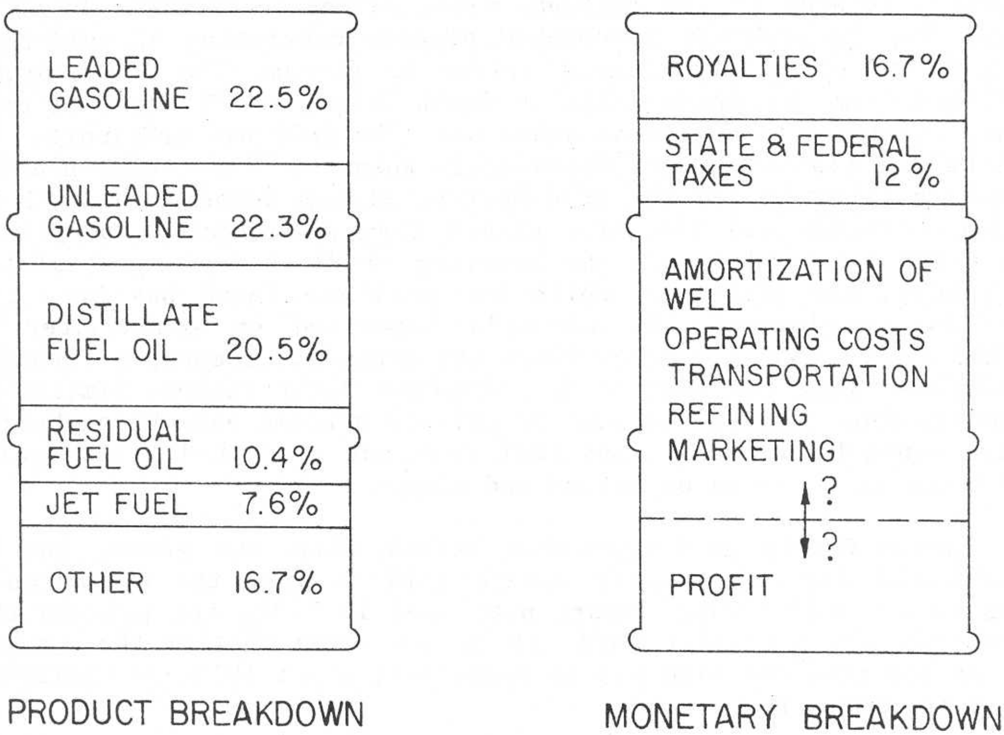



Figure 1. A typical breakdown of a 42-gallon barrel of oil.

## GOLD IN NORTH DAKOTA

--John Bluemle

Gold has never been, and probably never will be, an important mineral resource in North Dakota. Even so, the fact that small amounts of gold have been found in the state has helped to maintain at least some interest over the years in prospecting for it.

During the early part of the twentieth century, gold was discovered in the widespread sand and gravel deposits associated with glacial Lake Souris in McHenry, Bottineau, and Pierce Counties (fig. 1. Location map). The first known gold discovery dates to May, 1908, when L. E. Mills, D. B. Kauffman, and others recorded placer mining claims totalling 240 acres in Section 23, Township 156, Range 77 in McHenry County (about 3 miles east of Denbigh). It's not recorded exactly how much gold was involved in the discovery. By August of 1908, the people in this group had organized themselves into a company called the "Eldorado Gold Mining Company" and, as part of the articles of agreement, they pledged to "cooperate and purchase a dredge or mining boat of sufficient capacity to do the work in the best possible manner." Several other companies were formed at about this time too, but since the search was unsuccessful, it was soon abandoned and all of the companies ceased to exist.

At about the same time as the first "gold rush" in the Denbigh area, gold was also discovered about six miles north of Fort Ransom in southeastern North Dakota.

That deposit, located in the Sheyenne River valley in Sections 1 and 12, Township 136, Range 50, is probably a cemented placer, consisting of gold-bearing gravel that was deposited by a preglacial river or stream. The river probably flowed northeastward from the Black Hills in South Dakota in Pliocene or early Pleistocene time, perhaps 2 to 3 million years ago. The gold was transported by the river to North Dakota from the Black Hills area. When the Pleistocene glaciers advanced over the area, they buried the gold-bearing stream deposits beneath thick layers of glacial sediment and the only places they are exposed today are where the Sheyenne River has eroded away the covering of Pleistocene glacial sediments. In several places, the gravel in which the gold was found has been cemented to a concrete-like conglomerate by minerals deposited by groundwater that seeped through the gravel. Springs occur where the groundwater escapes through the gravel to the surface along the wall of the Sheyenne River valley. Similar gravels that were probably deposited in the same or related streams have been observed in parts of western South Dakota, in areas that were not glaciated. These gravel deposits commonly occur as caprocks on buttes and ridges.

The Ransom County gold operation lasted about two years, but the material being processed did not contain enough gold to make the operation profitable. According to an engineering report published in 1936, the gravels there assayed between \$5 and \$11 per cubic yard. It is not clear whether the assay referred to was done at the time the mine was in operation, about 1910, or whether it was done as part of the 1936 study.

The already-mentioned gold-bearing deposits associated with the glacial Lake Souris sediments in McHenry County were "rediscovered" in 1931 when reports from Chicago claimed that gold nuggets had been taken from the crops of turkeys grown near Denbigh. As soon as this information became general knowledge, the "rush" was on. Individuals and organizations filed placer claims and took mining leases until they covered every available piece of ground over a large area surrounding Denbigh and Towner.

The gold contained in the glacial Lake Souris gravel deposits was originally derived from rocks of the Canadian Shield. Glaciers moving southward over the Shield picked up gold-bearing materials and transported them southward. It is possible that the glaciers that transported the gold to north-central North Dakota flowed over the Gods Lake, Flin Flon, and Lac La Ronge mining districts of northern Manitoba and Saskatchewan. This part of the Canadian Shield is situated about 500 miles straight north of the Denbigh area and, based on our understanding of the flow direction of the Keewatin glacial ice, which affected North Dakota and areas to the north, it does appear to be in a likely position to have served as a source area for the gold. After the gold-bearing glacial sediments were dropped by the melting glacial ice, they were washed by streams of meltwater, which helped to concentrate the gold by removing the lighter weight material. Finally, the gold-bearing sediments were deposited on the floor of glacial Lake Souris as undercurrent fans at the mouths of the Souris and other rivers.

The discovery of gold in the turkey crops was followed by widespread rumors affirming and denying the existence of gold in commercial quantities. Many small operations were attempted in the early 1930s; they used a variety of methods of processing such as jigging, tabling, sluicing, cyanidation, and flotation. All of these were unsuccessful and lasted for only short periods of time at various places throughout the area.

In the summer of 1934, the School of Mines at the University of North Dakota obtained assistance from the Federal Emergency Relief Administration (FERA) to conduct a "Gold Investigation" project. In addition to the immediate area around Denbigh and Towner, this project investigated an area of about 3,000 square miles lying within the shoreline of glacial Lake Souris. J. C. Allen, in a progress report of the 1934 FERA project, stated that, during the course of the study, more than 5,000 samples were collected and shipped to the School of Mines at the University of North Dakota for assay and laboratory testing. Of approximately 1,500 samples assayed, 200 showed traces of gold and about 40 samples had values ranging from $0.17 a ton (a value corresponding to a gold content of 0.005 oz. per ton) to $2.10 a ton (0.06 oz. per ton). These values are based on a price of $35 an ounce for gold; at today's price of about $400 an ounce, the material would range in value from $2.00 to about $24.00 a ton. The samples with these values were scattered over 15 different plots of ground and they failed to indicate that anything of commercial importance exists in the area. The particles of gold examined were small, well rounded and worn, pitted, and flattened grains. Their condition suggested that the gold had been subjected to stream erosion and weathering, similar to gold found in modern placer deposits.

T. C. Barger summarized the FERA work project as follows:

"1. Gold is definitely present in the glacial gravel deposits.

2. The gold particles are extremely fine. (The largest nugget found by the survey was about twice the size of a grain of wheat, which, I believe was, and is, the largest single piece of naturally occurring gold yet found in the State).

3. The gold-bearing sands cover an immense area. Because of limited funds, it was not possible to investigate even all of the localities that had reported finding gold.

4. No deposits of commercial value were found in the areas prospected."

To summarize, nearly all gold-bearing deposits occur near acidic, igneous intrusions; the Black Hills of South Dakota are the best nearby example. Deposit types include magmatic, contact metamorphic, replacement (as lodes, or massive bodies, or disseminated through the rock), and cavity fillings. None of these are found in North Dakota. Gold can occur in association with a number of other minerals. Weathering and erosion can cause gold to be released from the above-described deposits, resulting in nuggets and grains, and in residual or stream placers. It is possible too, that gold may be found in some of the boulders that were carried to North Dakota by the glaciers from areas where gold occurs. The most likely possibility for gold occurrences in North Dakota is as stream placer deposits, the gold grains having been carried here by streams and glaciers from places outside the boundaries of the state; it is unlikely though that any large amounts of gold were ever concentrated by meltwater streams or glaciers in any single locality in North Dakota. As we discussed earlier, minute amounts of gold are known to be disseminated through the gravels that were deposited in the glacial Lake Souris area by glacial meltwater and any number of attempts have been made to recover this gold as a by-product of routine gravel-washing operations.

Many discoveries of gold not mentioned in this discussion have been reported over the years in North Dakota, as well as a number of "scams" designed to incite

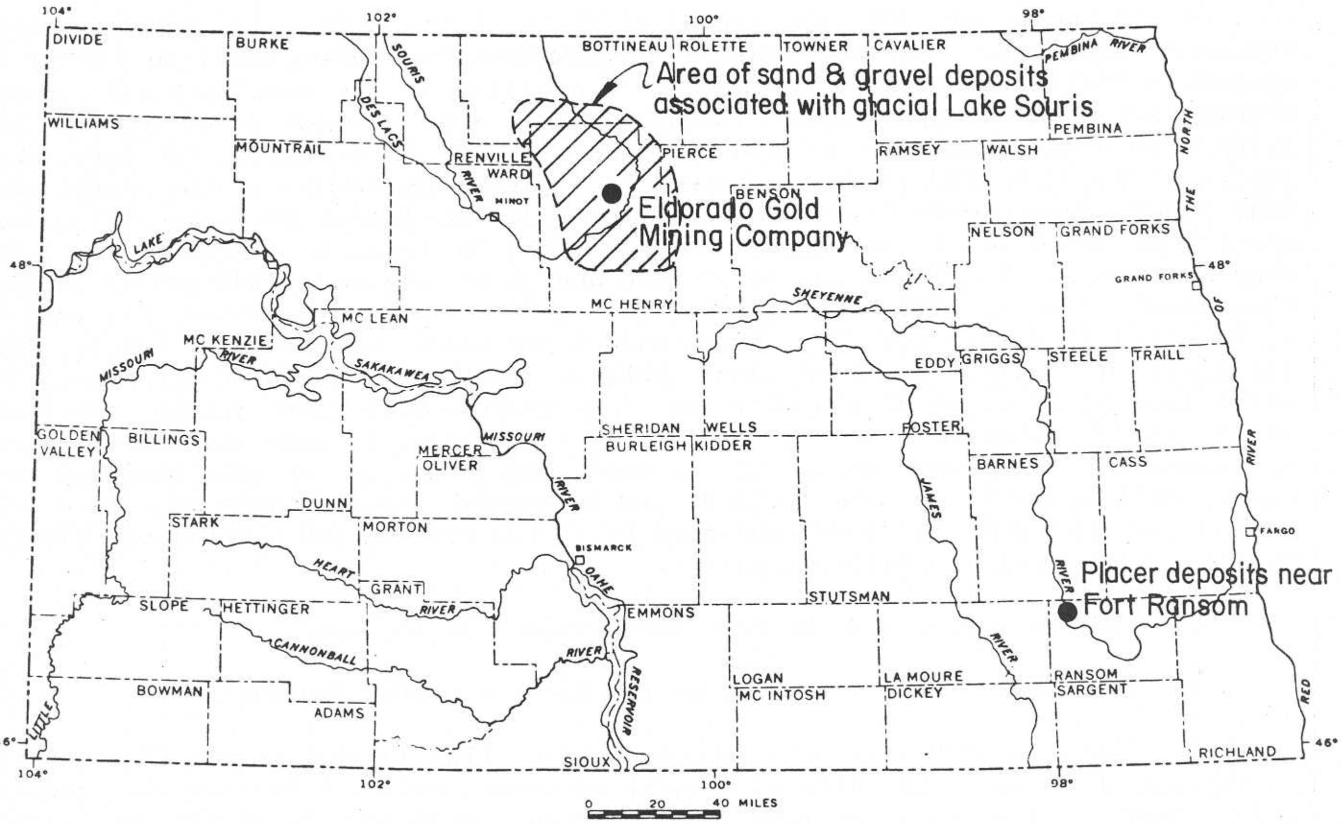



Figure 1. Location map showing areas where gold was once mined in North Dakota.

"gold fever" and separate people from their money in various ways. I won't go into any of these schemes here. The fact that North Dakota has none of the rock types normally associated with gold-bearing deposits makes it unlikely that significant amounts of gold will ever be found here.

COMMENTS

Do you have questions, comments, or suggestions regarding the newsletter or North Dakota Geological Survey services? For additional information on any of the items mentioned in the Newsletter, please contact John Bluemle, NDGS Newsletter Editor, North Dakota Geological Survey, University Station, Grand Forks, ND 58202-8156.

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