OIL & GAS CONSERVATION COMMISSION
Meeting: July 19, 1967
Mr. John Bannister, Exec. Secy.

OFFICE OF

Oil and Gas Conservation Commission

STATE OF ARIZONA

ROOM 202

1624 WEST ADAMS

Phoenix, Arizona 85007

PHONE: 271-5161

A G E N D A

Meeting

July 19, 1967

9:30 a.m. Call to order

1. Approval of minutes of meeting of June 21, 1967. ✓
2. Exeuctive Secretary's Report ✓
3. Geologist's Report ✓
4. Old Business ✓
5. New Business
   Maps: Loc & Revised. Budget.
6. Adjourn

10:00 a.m. Hearing, Case 21, Cottonwood Oil Co., Yavapai Oil Corp., and Richard F. Harless

1:30 p.m. Hearing, Case 26, to establish pool and special field rules for Dineh bi Keyah.
Arizona Highway Department Auditorium, 206 S. 17th Avenue, Phoenix.

OIL AND GAS CONSERVATION COMMISSION
1624 West Adams - Suite 202
Phoenix, Arizona

Minutes of Meeting
June 21, 1967

Present:
Mr. Lynn Lockhart, Chairman
Mr. Lucien B. Owens, Vice Chairman
Mr. George T. Siler, Member
Mr. Kenneth G. Bentson, Member
Mr. John Bannister, Executive Secretary
Mr. James R. Scurlock, Geologist
Mr. Alfred Morgan, Yuma, Arizona
Mr. Harold Ferrin, Mesa, Arizona
Mr. O.B. Lassen, State Land Commissioner
Mr. F.C. Ryan, State Land Department
Mr. Bob Hubbard, State Tax Commission
Mr. James R. Pickett, Phoenix, Arizona
Mr. Francis J. Ryley, Phoenix, Arizona

Absent:
Mr. Hiram S. Corbett, Member

Meeting called to order at 9:30 a.m. Minutes of meeting of May 17, 1967 were approved.

The executive secretary was instructed to re-schedule the hearing for Case 21 (Harless-Cottonwood Oil Co. Inc.-Yavapai Oil Corp.) for July 19, 1967 at 10:00 a.m., and to comply with the Attorney General's letter of June 7, 1967 in notifying the principals.

The executive secretary was instructed to set up a hearing for 1:30 p.m. on July 19, 1967 to consider establishing a pool and special field rules for Dineh bi Keyah and to arrange for the services of Mr. E.N. Walsh, consulting petroleum engineer, in connection with this hearing. The executive secretary further was directed to request an opinion from the Attorney General as to the applications of the statute and rules and regulations concerning confidential information developed in a proven area.

In reply to Mr. Harold Ferrin's verbal request to the Commission, Mr. Bentson moved that an extension of time to January 1, 1968 be granted to Mr. Ferrin in which to resume his operations under Permit 344, the Ferrin #1 NMA well, and Permit 350, Ferrin #1 Aja Cattle Co.-Babbit Bros. well, providing that logs and all information that is over six months old be made available to the public. Motion carried.

It was further decided that this action would not set a precedent

for all requests for extensions of time, that is, requests for temporary abandoment in accordance with Rule 202.B, but that each extension would be judged on its own merits.

Mr. Owens moved that from hereon the Commission's policy would be that when a well is declared temporarily abandoned by the Commission that the confidential period will continue for six months from the date of temporary abandonment and that all logs, samples, and other required information would be submitted from that date rather than from the completion date. All wells classified as temporarily abandoned prior to this day will be held in a confidential status for six months from July 1, 1967, and all logs, samples and other required information will be submitted from that date. Motion carried.

The executive secretary was instructed to issue a directive embodying this policy and to mail it to all operators.

The executive secretary was also directed to issue plugging orders to operators of the C & J Drilling #1 State well, the Potter #1 State well, the Southwest Oil C. #1 Davis-Clark well, and the Ari-Mass #1 State well.

OFFICE OF

Oil and Gas Conservation Commission

STATE OF ARIZONA

ROOM 202

1624 WEST ADAMS

Phoenix, Arizona 85007

PHONE: 271-5161

July 11, 1967

Memo to: Commissioners
From: John Bannister, Executive Secretary

Re: Report of Activity

I contacted Mr. Walsh, Farmington, New Mexico, pursuant to the upcoming hearing on the Dineh bi Keyah field.

It is our thought at this time, that the Rules and Regulations in existence are more than sufficient to cover the needs of the field. However, we feel that for this pool, if established, as the result of this hearing, Rule 301 should be ammended to call for a gas/oil ratio test quarterly, this test to be done in January, April, July, and October, and the reports to be submitted by the 10th of the following month.

We further feel that a reservoir pressure test, Rule 302.B, should be made early in June, annually, and the results filed with the Commission by the 10th of the following month.

Other than these we see no need for any other specific changes to our rules. However, evidence will be presented by the operators on their own behalf.

It is our thought that Mr. Scurlock will take the stand and testify as to the presence of the sill and the areal extent thereof. He will be followed by Mr. Walsh who will speak for the need to ammendments to Rule 301 and Rule 302. Both of course will be subject to cross-examination.

It is the thinking at this time of both Mr. Walsh and myself that the initial pool should cover 160 acres surrounding each oil well with a buffer zone extending a mile therefrom . As a new well comes in, the order should provide administrative expansion of the pool and the buffer zone, with appropriate 160-acre well dedications and rules to be applicable within the one-mile buffer zone.

I have requested an opinion from the Attorney General's office

concerning the status of confidential information once the area is declared a pool. As you recall, the statutes read that in an unproven field the operator has the right to the six months confidential period. I pointed out to the Attorney General that his answer should be in this office in time to be available for the hearing.

Registered notices, pursuant to the Attorney General's instructions, were sent to all interested parties in the Harless wells, and post office receipts on all have been returned.

The Attorney General has been requested to have a representative present at both hearings.

While in Farmington I took the opportunity of going to the Dineh bi Keyah field to view the installing of the pipeline. The line will be some 35 miles in extent, from Kerr-McGee's tank battery, going in a northeasterly direction to a point approximately eleven miles south of Shiprock, where it will cross the highway and on to the Four Corners Pipline. The route has been so designed that should the capacity of the Four Corners Pipeline be reached, oil then can be diverted into the Texas-New Mexico line which carries crude to Texas.

It is anticipated that this line will be operative sometime in July. It is an eight-inch O.D. pipe with a capacity of approximately 15,000 barrels per day under gravity flow, and of approximately 40,000 barrels per day under pressure (pump).

You will note enclosed is a copy of a directive issued pursuant to your instructions concerning wells under temporary abandoment and in a confidential status. Letters have been sent to all operators having wells in this category. The directive has been sent to every one on our mailing list.

I attended the funeral for Mr. Corbett in Tucson on July 8th. It was well attended and handled with great dignity. Goverynor Williams was present. The office has offered any possible assistance to Mrs. Corbett and has sent a letter of condolence and flowers from the Commission. The bill will be approximately $10.40.

A meeting of IOCC Subcommittee on Statistics will be held in Dallas on July 17 and 18. As a member of this committee I plan to attend. The purpose of this committee is to seek standardization in reporting to the federal government.

As usual, this office must submit a proposed budget for 1968-69 to the Commissioner of Finance by September 1st. Attached please find a suggested budget. This proposal is equivalent to the budget granted for 1967-68 and including the supplement we are requesting.

New Permits:

Kerr-McGee #13 Navajo, SE SW 31-36N-30E, Apache County

OFFICE OF

Oil and Gas Conservation Commission

STATE OF ARIZONA

ROOM 202

1624 WEST ADAMS

Phoenix, Arizona 85007

PHONE: 271-5161

June 11, 1967

Memo to: Commissioners
From: J.R. Scurlock, Geologist

Re: Activities Report

June 30th:

Sedona: Harless-no activity; no change

July 5th and 6th

Pan American V-1 Navajo. Total depth 4445'. Dry and abandoned.

Horizon 1-24 Navajo-Mobil. Total depth 6452' in pre-Cambrian. Dry and abandoned.

New Location. Kerr-McGee #13 Navajo (Dineh bi Keyah). SE SW Sec. 31-36N-30E.

Dineh bi Keyah. (Six wells on Production)

Kerr-McGee #5 Kerr-McGee #B-1	Temporarily abandoned
Kerr-McGee #4 Kerr-McGee #16	Drilling
Kerr-McGee #6 Kerr-McGee #14 Kerr-McGee #15	Being completed

Resume Arizona Production 1967

	Total Ariz.		
January	12,035	barrels oil	
February	23,035	" "	(one well @ Dineh bi Keyah)
March	72,157	" "	(two wells @ Dineh bi Keyah)
April	171,982	" "	(four wells @ Dineh bi Keyah)
May	281,816	" "	(six wells @ Dineh bi Keyah)

OFFICE OF

Oil and Gas Conservation Commission

STATE OF ARIZONA

ROOM 202

1624 WEST ADAMS

Phoenix, Arizona 85007

PHONE: 271-5161

D-1-66
June 21, 1967

POLICY
CONFIDENTIAL INFORMATION FROM
WELLS IN TEMPORARY ABANDONED STATUS
(See Rule 202.B)

The Commission in its regular meeting of June 21, 1967 has established the following policy as to the confidential status of a well which has been temporarily abandoned:

(A) That as of June 21, 1967 all information on a well thereafter classified as temporarily abandoned shall become public information six months from the date on which it is so classified. All information, logs, samples and other reports ordered by the Commission shall be timely submitted as if the well had been completed on the date of its temporary abandonment.

(B) Wells classified as temporarily abandoned prior to June 21, 1967 will be given the period from July 1, 1967 until December 31, 1967 as the period during which information will be held confidential. Time of filing reports, logs, samples, etc., will run as of that date.

If you have any questions regarding this directive please contact this office.

WELL STATUS REPORT AND GAS-OIL RATIO TESTS

Operator________________________ Field and Reservoir________________________

Address________________________ Month________________________ County________________________

Federal, State or Indian Lease Number, or Lessor's Name if fee lease	Permit No.	Well No.	Date of Test	Status	Choke Size	Pressures				Separator Temp. °F	Daily Allowable	Length of Test (Hrs.)	Production During Test				Gas-Oil Ratio Cu. Ft. Per Bbl.
						Tbg.	Csg. Beginning	Csg. End	Separator				Wtr. Bbls.	Grav. Oil	Oil Bbls.	Gas MCF	

All Tests Reported herein were made in accordance with the Applicable Rules, Regulations and Instructions of the State of Arizona Oil & Gas Conservation Commission

CERTIFICATE: I, the undersigned, under the penalty of perjury, state that I am the...of the ....(company), and that I am authorized by said company to make this report; and this report was prepared under my supervision and direction and that the facts stated therein are true, correct and complete to the best of my knowledge.

....
Date

....
Signature

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION
Well Status Report and Gas-Oil Ratio Tests
Form No. 5 File One Copy

WELL STATUS REPORT AND GAS-OIL RATIO TESTS

Operator _____ Field and Reservoir _____ County _____

Address _____ Month _____

Federal, State or Indian Lease Number, or Lessor's Name if fee lease	Permit No.	Well No.	Date of Test	Status	Choke Size	Pressures				Separator Temp. °F	Daily Allowable	Length of Test (Hrs.)	Production During Test				Gas-Oil Ratio Cu. Ft. Per Bbl.
						Tbg.	Csg. Beginning	Csg. End	Separator				Wtr. Bbls.	Grav. Oil	Oil Bbls.	Gas MCF	

All Tests Reported herein were made in accordance with the Applicable Rules, Regulations and Instructions of the State of Arizona Oil & Gas Conservation Commission

CERTIFICATE: I, the undersigned, under the penalty of perjury, state that I am the.....of the .....(company), and that I am authorized by said company to make this report; and this report was prepared under my supervision and direction and that the facts stated therein are true, correct and complete to the best of my knowledge.

..... Date

..... Signature

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION

Well Status Report and Gas-Oil Ratio Tests

File One Copy

Form No. 5

INSTRUCTIONS

Show all data requested for each well separately, and determine the gas-oil ratio according to the following procedure:

(1) General:

(a) Each well shall have produced its current daily allowable, if such well is capable of producing such allowable, during the 24 hour period immediately preceding the test, and the well shall be producing at the time the actual test begins.

(b) The volume of gas used in computing the gas-oil ratio and reported as being produced during the test (except tests on gas lift or jetting wells) shall be the total volume of gas produced from the well in the test period. This total volume of gas shall include all gas withdrawn from the casing as well as that produced through the tubing.

(c) The amount of oil produced during the test shall not be less than the well's then current daily allowable (if the well is capable of producing its allowable) and shall not exceed the daily allowable by more than ten (10) per cent, except that in the case of a well having an allowable already penalized due to its gas oil ratio, the operator may select any rate he desires between the penalized allowable and ten (10) per cent above the unpenalized allowable.

(2) Flowing Wells That are Produced Continuously:

The oil flow shall be stabilized during the 24-hour period immediately preceding the test. Adjustments in the rate of flow should be made during the first 12 hours of the stabilization period and no adjustments shall be made during the last 12 hours or during the time in which the well is being tested.

(3) Flowing Wells That are Produced Intermittently (Stop-cocked):

In computing the operating gas-oil ratio, the total volume of gas and the total barrels of oil produced during the 24 hour test period must be used regardless of the flowing time in the 24 hour period. On wells which are stop-cocked, both the closed-in casing pressure at the beginning of the test period and the closed-in casing pressure at the conclusion of the test must be shown and properly identified on the report. The closed-in casing pressure at the end of the 24 hour test period shall not exceed the closed-in casing pressure at the beginning of the test period by more than six-tenths (0.6) pounds per square inch per barrel of oil produced during the test.

(4) Gas Lift or Jetting Wells:

In submitting gas-oil ratio tests for gas lift or jetting wells, the total input and total output gas volumes shall be reported separately. These volumes shall be properly identified and determined by continuous measurement during the test. The volume of gas used in determining the operating gas-oil ratio hereunder shall be the volume remaining after the total input gas has been deducted from the total output volume.

(5) Pumping Wells:

In computing the operating gas-oil ratio, the total volume of gas and the total barrels of oil produced during the test period must be used regardless of the pumping time in the test period.

(6) Definitions:

Under Status, use the following symbols: F—Flowing, P—Pumping, GL—Gas Lift, SI—Shut In, D—Dead, TA—Temporarily Abandoned, GI—Gas Injection, WI—Water Injection.

Under Pressure, show the stabilized working pressures on the tubing, and casing, at the rate at which the well is tested. The Gas Production listed shall be the total volume of gas produced during the test in thousands of cubic feet (MCF) measured at a base pressure of 15.025 pounds per square inch, absolute, and a standard base and flowing temperature of 600 Fahrenheit; correction to be made for pressure according to Boyles Law, and for specific gravity according to test made by the Balance Method. All well status and gas-oil ratio tests submitted to the Commission on this form shall be made by a person qualified by training or experience to make such tests. Methods of gas measurement used shall be those prescribed by the State of Arizona Oil & Gas Conservation Commission

Form No. 5

RESERVOIR PRESSURE REPORT

Operator | Address

Field | County | Date

Producing Formation | Oil Gradient | Water Gradient | Initial Completion* | Special* | General Survey* | Datum Plane | Gas Gravity

Well Name	Permit No.	Well No.	Oil (O) or Gas (G)	Date Tested	Shut-in Time	Shut-In Tubing Pressure	Bomb Test Data			Sonic Instrument Test Data						Pressure At Datum
							Test Depth	B.H. Temp.	Observed Pressure	Prod. Test (Bbls per Day)		Liquid Level	Liquid Gradient	Wt. of Liquid Column	Wt. of Gas Column	Casing Pressure	
										Oil	Water						

* Designate type of report by "x".

CERTIFICATE: I, the undersigned, under the penalty of perjury, state that I am the.....of the .....(company), and that I am authorized by said company to make this report; and this report was prepared under my supervision and direction and that the facts stated therein are true, correct and complete to the best of my knowledge.

.....
Date

.....
Signature

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION
Reservoir Pressure Report
File One Copy
Form No. 7

STATE OF ARIZONA

BUDGET ESTIMATES AND REQUESTS

SCHEDULE I
Page 1 of 3

Agency Name _____

Item	Object Code	Expenditure Classification	(1) Actual Expenditures 1966-1967	(2) Estimated Expenditures 1967-1968	(3) Requested for 1968-1969	(4) Amount of Increase (Decrease)	(5) Recommendation Executive	(6) Recommendation Legislative
		PERSONAL SERVICES						
1		Total Number of Positions	8	8	9			
2	100	Salaries and Wages	29,499.00	29,500.00	46,550.00	17,050.00		
		CONTRACTUAL SERVICES						
3	211	Postage	467.22	750.00	750.00	-		
4	212	Telephone & Telegraph	1,562.31	2,000.00	2,000.00	-		
5	215	Heat, Light, Power & Water						
6	220	Travel - State	4,720.13	5,000.00	5,000.00	-		
7	230	Travel - Out of State	2,190.46	2,500.00	3,500.00	1,000.00		
8	240	Professional Services	818.30	2,000.00	5,000.00	3,000.00		
9	260	Maintenance & Repairs (office equip)	105.28	115.00	115.00	-		
10	~~270~~ 294 / 295 / 290	~~Care of Institutional Wards~~ (Legal advt / Transport Samples / copy service)	403.16 / 16.36 / 243.18					
11	~~280-290~~	Other Contractual Services		1,500.00	1,500.00	-		
		SUB-TOTAL	10,526.40	13,865.00	17,865.00	4000.00		
		SUPPLIES, MATERIALS & PARTS						
12	310	Office Supplies	1,057.10	2,500.00	2,500.00	-		
13	321	Food						
14	322	Household Supplies						
15	324	Drugs, Medical & Surgical						
16	325-328	Other Institutional Supplies						
17	350	Vehicle Supplies						
18	360	Special Supplies (Drafting Supplies / coordinated Logs)	387.45 / 1.42	600.00	600.00	-		
19	370-390	Other Supplies, Materials & Parts (door stop / Film,)	87.40	100.00	100.00	-		
		SUB-TOTAL	1,532.37	3,200.00	3,200.00	-		

STATE OF ARIZONA

BUDGET ESTIMATES AND REQUESTS

SCHEDULE I
Page 2 of 3

Agency Name _____

Item	Object Code	Expenditure Classification	(1) Actual Expenditures 1966-1967	(2) Estimated Expenditures 1967-1968	(3) Requested for 1968-1969	(4) Amount of Increase (Decrease)	(5) Recommendation Executive	(6) Recommendation Legislative
		CURRENT FIXED CHARGES						
20	411-414	Rent - Equipment Copy machine	199.76	360.00	360.00	-		
21	413	Rent - Buildings & Offices						
22	424	Insurance - Bldgs. & Equipment						
23	428	Insurance - Liability						
24	421-429	Insurance - Other						
25	425	Employer Contribution - Retirement						
26	427	Employer Contribution - FOASI						
27	430	Subscription & Organization Dues	165.65	180.00	180.00	-		
28	440-490	Other Current Fixed Charges						
		SUB-TOTAL	365.41	540.00	540.00	-		
		FIXED CHARGES						
29	520	Pensions & Relief Payments						
30	540	Apportionments						
31	510-590	Other Fixed Charges						
		SUB-TOTAL						
		CAPITAL OUTLAY						
32	610 611 614 Table Equip	Equipment	113.36 1,977.71					
33	620	Buildings & Improvements						
34	630-660	Other Capital Outlay						
		SUB-TOTAL	2,091.07					

STATE OF ARIZONA

BUDGET ESTIMATES AND REQUESTS

SCHEDULE

Agency Name _____

Item	Object Code	Expenditure Classification	(1) Actual Expenditures 1966-1967	(2) Estimated Expenditures 1967-1968	(3) Requested for 1968-1969	(4) Amount of Increase (Decrease)	(5) Recommendation Executive	(6) Recommendation Legislative
35	700-900	OTHER EXPENDITURES (SPECIFY)						
		277 Ariz Bu Mines Museum N. Ariz.	2,500.00	2,500.00	2,500.00	—		
			2,500.00	2,500.00	2,500.00	—		
		SUB-TOTAL	5,000.00	5,000.00	5,000.00	—		
		TOTAL EXPENDITURES	49,014.25	52,105.00	73,155.00	21,050.00		

SOURCE AND DISPOSITION OF FUNDS

Source of Funds				
Balance Forward From Prior Year				
General Appropriation		54,450.00	52,105.00	
Special Appropriation				
Appropriated Receipts				
Federal Funds				
Other (Specify)				
TOTAL		54,450.00	52,105.00	
Disposition of Funds				
Expenditures		49,014.25	52,105.00	
Other (Specify)				
Amount Reverted		5,435.75	0	
Balance Forward To Next Year		0	0	
TOTAL		0	0	

Note:
ARS 27-523 provides that all monies collected by the commission shall be deposited in a special fund (Oil & Gas Conservation Fund, 1-7-10-060-0000) and that expenditures therefrom are subject to legislative appropriation.
6-30-67 balance $10,320.25

SCHEDULE II

STATE OF ARIZONA

SUMMARY OF POSITIONS AND SALARIES

Agency Name _____

Title of Position	1966-1967		1967-1968		Request for 1968-1969					
	No.	Actual Expenditures	No.	Estimated Expenditures	No.	Current Positions	No.	Additional Positions	No.	Total Positions
Executive Secretary	1	12,000.00	1	12,000.00	1	15,000.00			1	15,000.00
Geologist	1	9,300.00	1	9,300.00	1	10,800.00			1	10,800.00
Secretary-bookkeeper	1	5,280.00	1	5,280.00	1	6,600.00			1	6,600.00
Administrative Assistant							1	8,400.00	1	8,400.00
Commissioner	5	2,775.00	5	2,900.00	5	3,750.00			5	3,750.00
Extra help (clerk-typist)	1	144.00		20.00				2,000.00		2,000.00

SCHEDULE II-A

STATE OF ARIZONA

TOTAL COST OF ADDITIONAL POSITIONS REQUESTED

Agency Name _____

Title of Position	No.	Salary	Employer Contributions	Other Costs		Total
				Expenditure Classification	Amount	
Administrative Assistant	1	8,400.00				
Extra help		2,000.00				

STATE OF ARIZONA

SCHEDULE

1968-1969 REQUEST FOR PROFESSIONAL SERVICES

Agency Name _____

Type of Service	Purpose of Service	Amount of Request
Court reporter	ARS 27-517 provides that any interested persons shall have the right to a hearing and that a court reporter shall be present throughout.	1,800.00
Laboratory Analysis	To confirm oil/gas samples	200.00
Petroleum Engineer	Consultant, on retainer basis. To compile and evaluate technical data for defining pools and for unitization plans. To perform reserve evaluations, to recommend and advise concerning testing, injection programs, mechanics in drilling, reworking, or recompletion, or secondary recovery programs to increase production, thereby fulfilling the charge of conservation.	3,000.00

How unique Arizona syenite oil reservoir formed

Anticline controls accumulation in sill intruded into Pennsylvanian beds in Tertiary time

Dr. Willard D. Pye, Professor of Petroleum and Geophysics, University of Arizona, Tucson

25-second summary

Northeastern Arizona's syenite oil reservoir at Dineh bi Keyah field has the following characteristics. It is evidently of Early Miocene or Late Oligocene age. Radioactive determinations indicate that it is about 31 million years old. The syenite body was evidently intruded into Pennsylvanian strata during the time just mentioned. The intrusion is roughly parallel to bedding planes, so it is deemed a sill. Oil accumulation may not be confined to the sill—adjacent strata may contain oil also as part of the same reservoir. Accumulation is structurally controlled, so exploration for similar nearby fields should seek structural highs. Radiation, acoustic and induction logs, when cross-correlated, have been effective for evaluation of this unique reservoir.

THE DINEH BI KEYAH ("people's field" in Navajo) field lies in eastern Apache County, Arizona along the crest of the Toadlena anticline. The field has six wells producing oil from the same section. Current production is from an igneous intrusion in Pennsylvanian strata.[1]

Oil output is holding up well, though produced to capacity of pumping equipment. Either there is no drawdown, or pressure recovery is rapid.

Kerr-McGee Corp. has two rigs working, and Humble Oil & Refining Co. is also drilling in this field. From core information and production experience so far, the area's potential looks good. It will be important to determine if production is confined to the igneous intrusive or whether it will be found also in adjacent porous Pennsylvanian sedimentary beds.

Production will probably be scattered locally near the crest of the anticline where porosity and permeability exist. The anticline has had several dry holes drilled on it at various localities.

Unique reservoir rock. Samples and cores indicate that the producing horizon is a syenite intrusion into Pennsylvanian sediments. Syenite is an igneous rock closely related to granite.

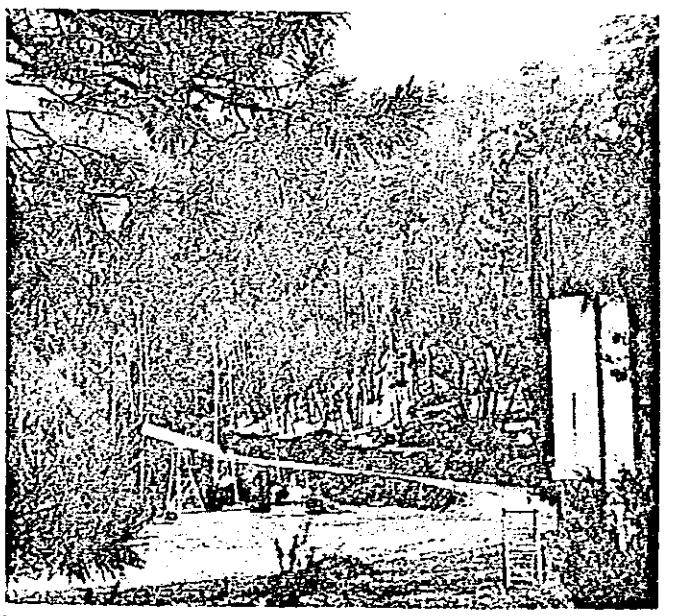
Syenites are phanerites (i.e., rocks composed more than 50 percent of minerals large and distinct enough to be seen and recognized by the unaided eye or with a lens) composed largely of orthoclase. Syenites differ from granites in containing no quartz or a negligible amount of it. A fairly detailed breakdown of mineral composition in this zone at 3,060-3,152 feet in Kerr-McGee's Navajo 2 well was published in the literature cited.[1]

Syenite is crystalline, and normally would have only minimal porosity and permeability. Fracturing and granulation may possibly create intergranular porosity or permeability. If the intrusion is parallel to sedimentary bedding planes, it is a sill. If not, it is a dike. The field's pay zone appears to be intruded in the field area nearly parallel, and could be called a sill.

The sill ranges from less than 100 feet to more than 125 feet thick in different wells. Sills are local features and may be absent in some wells drilled outside of the field.

The sill was probably intruded into Pennsylvanian beds in Late Oligocene or Early Miocene time. Radioactive determinations have yielded ages of about 31 million years for this particular intrusive.

The sill is located some 250 feet above the Pennsylvanian-Mississippian contact. In places, sedimentary rocks above the intrusive are carbonaceous, possibly in part the result of heat action which may have distilled oily matter



Kerr-McGee's Navajo 1 oil well was completed successfully in the rugged Chuska Mountain area of Apache County, Arizona, early in 1967.

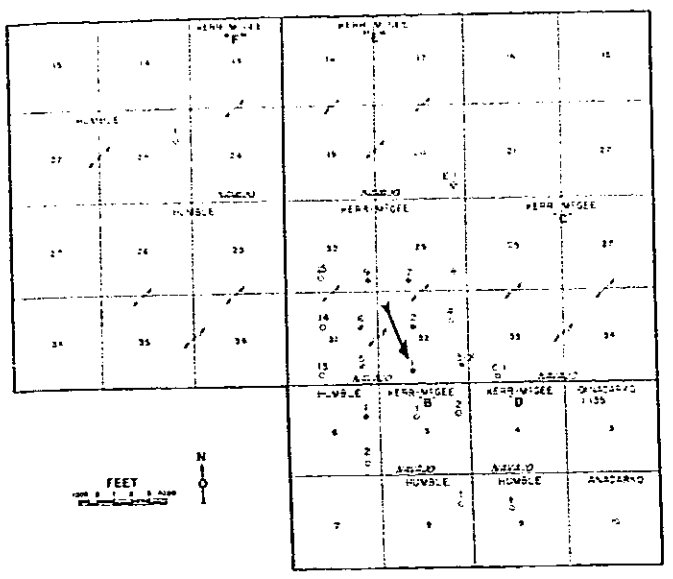


Fig. 1—Map shows wells, and locations staked or drilling in Dineh bi Keyah field, Lukachukai area, Apache County, northeastern Arizona, on the Defiance uplift north of Canyon de Chelly National Monument. Discovery well, Kerr-McGee Corporation Navajo 1, located in Section 32, Township 36 north, Range 30 east is indicated by arrow. Dineh bi Keyah may prove to be a major oil field. As of late May, only dry hole drilled since completion of the discovery well was located to the east, drilled by Anadarko Production Co. in northwest corner of Section 3, T35N R30E.

into the overlying sandy beds. Shales may underlie the sill.

The sill generally dips northeastward in the area now being drilled. Whether it dips exactly parallel to enclosing rocks and thus follows the folded structure or whether it cuts across structure has yet to be determined.

The oil-bearing igneous rock is the first of its type found productive in Arizona. Generally oil is not found with igneous rocks since they usually lack porosity and permeability, unless they have been fractured or weathered. If they are intrusives into sedimentary sections, they were hot and probably would have destroyed or distilled off nearby hydrocarbons at the time of intrusion. Where oil is found in igneous or metamorphic rocks it is usually associated with truncated sedimentary beds from which oil has migrated into adjacent crystalline rocks. Such new host rocks must have porosity and permeability to receive oil.

The Conejo, Edison and El Segundo fields, and various fields in Kansas, to mention a few in the U. S., produce from pyroclastics, intrusive basalts, andesite dikes and Precambrian granites. However, rarely is such production commercially important.

Other oil occurrences in igneous reservoirs may be found elsewhere on the Defiance uplift and in the Black Mesa basin. However, other types of accumulations are more likely to occur. Oil can migrate and accumulate in any porous and permeable rock. It was fortuitous that in Dineh bi Keyah field a sill was at the proper location and sufficiently fractured to provide porosity and permeability.

If the sill had not been there, some other reservoir rock and trap might have caught and held the oil. The oil source is still unknown, though this can probably be determined by analysis of oil samples. Possibly the heat of the sill was the agent that distilled or released it. In this case, presence of the igneous body may be significant to a peculiar type of oil origin and accumulation.

Dikes and sills need not be tectonically fractured - they can be fractured by cooling, and may have porosity and permeability developed by gas release, flow and similar mechanisms.

It would be better to seek oil fields in the Black Mesa basin and on the Defiance uplift based on other criteria than to try to find another igneous field.

Main search still for structures. Despite the fact that oil was found in igneous rock, the primary controlling factor is the structural trap, together with a reservoir rock and source beds. So exploration methods to determine such traps should be used. Surface mapping, subsurface studies and seismic methods should all work well in the Dineh bi Keyah area. The geology is relatively simple insofar as structure is concerned, but Tertiary cover sometimes masks it, as do Permian and Mesozoic rocks which cover the truncated older Paleozoic beds. Numerous local facies changes may occur.

The Toadlena or Lukachukai[1] anticline is a well-developed structure, expressed in Tertiary and older beds. The anticline is 35 or more miles long and trends in a northwest-southeast direction. It is asymetrical, with beds dipping to about a maximum of five degrees to the northeast on the eastern flank of the anticline, and substantially steeper southwest dips on the west flank of the structure.

O'Sullivan and Beikman[2] indicate that the closure of the structure is several hundreds of feet, and that the structure plunges both to the southeast and northwest.

Expected along the crest of the main anticline feature are local highs or domes which will probably be the significant oil-bearing parts of it. The Dineh bi Keyah sill is found near the crest of the structure at a depth of 2,800 to 3,300 feet. Other igneous dikes and intrusions have been found on the structure in Tertiary beds. Some of these have been reported to have been folded along with the enclosing rock. Other interpretations have been that the intrusion followed the folded bedding plane.

Some geologists who have worked in the area have considered the igneous rocks to be lava flows. If the Dineh bi Keyah igneous body is a flow, it would have to be of Pennsylvanian age. This fits neither the presently-known geological history of the area nor radioactive dating of the reservoir rock.

Some have considered the igneous bodies to the "granite wash" or similar type of material derived from adjacent Pennsylvanian uplifts undergoing rapid erosion.

The Defiance uplift and other structures in northeastern Arizona have excellent possibilities for a wide variety of stratigraphic traps. From Devonian time on, the area underwent gentle warping and uplifting, resulting in truncation of various parts of the section and development of solution porosity. Deposition was rapid and varied, and ranged from shelf and strand line types of both clastic and carbonate sediments to evaporite accumulations. Reefs, bars, shoreline features and depositional basins are all present in various areas.

During Permo-Pensylvanian time, relief became greater, continental types of sedimentation more pronounced, and erosion deeper.

As a result, Devonian, Mississippian and Pennsylvanian beds are all serious targets in northeastern Arizona, and have all produced in the Four Corners area. The Triassic and Jurassic are mainly continental deposits. The Cretaceous is (essentially) only present in the Black Mesa basin, and is relatively thin compared to the New Mexican Cretaceous section.

Well logging. Radiation logs, and electrical surveys including the induction log will probably be most useful and likely to detect hydrocarbons in reservoirs similar to Dineh bi Keyah. The sonic log may be useful after it has been interpreted together with other types.

The induction log did not show the oil saturation on the discovery well, but has been effective for this purpose in later wells.

It is still the fluid content that is important, and unless there is high mineralization—much more than is normal in this kind of igneous rock unless it is in a mineralized area—any of the fluid-detecting devices should be effective.

If it is desired to find a sill or its horizontal limits, a magnetic survey might be effective.

Discovery of Dineh bi Keyah field is significant because it emphasizes Arizona's oil potential which has remained largely unexplored. Though numerous wells have been drilled in the state, many of them have not adequately tested the section. Though the discovery enhances the northeastern or Four Corners part of Arizona, the southeastern part of the state has about 10,000 feet of essentially untested marine section, and the northwestern part has a thick marine section also.

The southeastern part may have some potential based upon the adjacent Mexican geology, but prospects are largely concealed. Each quadrant of Arizona has different geological characteristics, each with advantages and disadvantages as to likely oil occurrence. Each will require specialized exploration techniques.

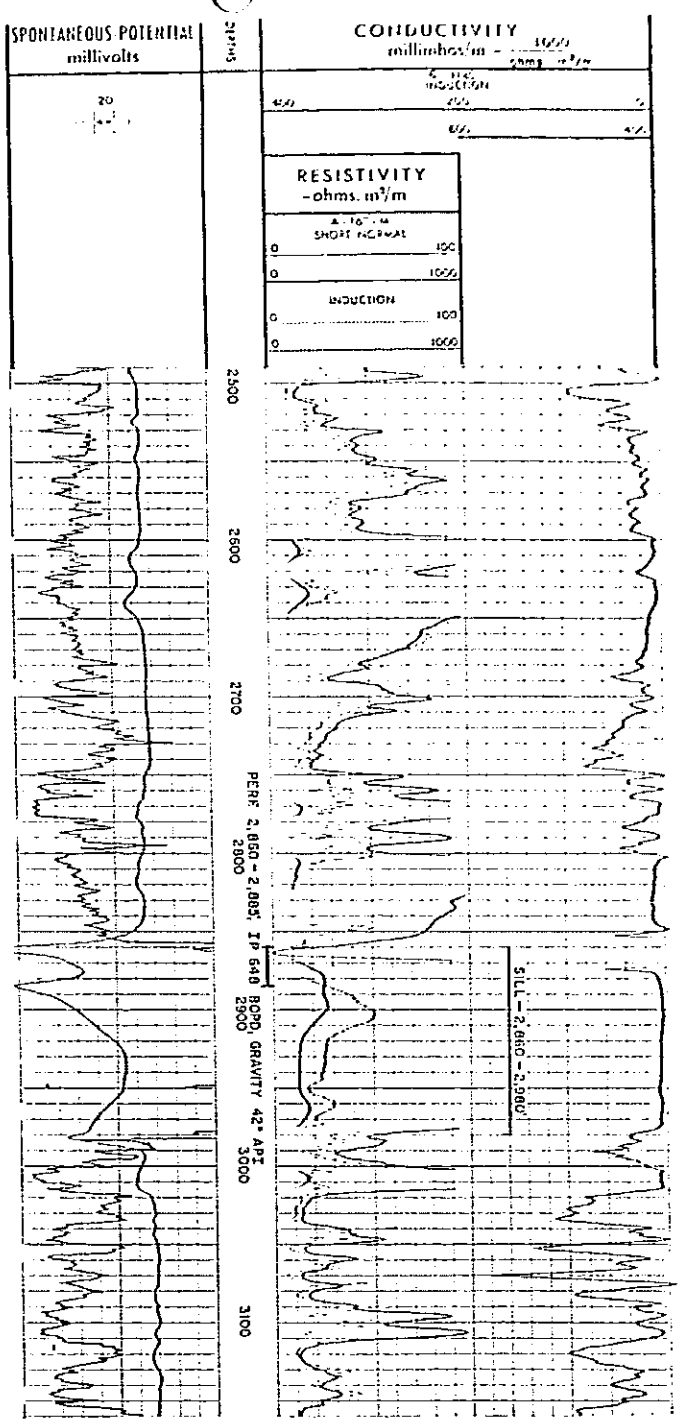


Fig. 2—Portion of field copy of induction electrical log of Kerr-McGee Corp. Navajo 1 well, run on Feb. 17, 1965, before well was plugged and subsequently re-entered for completion as an oil discovery. Top of Pennsylvanian (not shown) was encountered at 1,305 feet. Syenite sill is between 2,860 and 2,980 feet. Perforated interval is 2,860-2,885 feet. Total depth logged was 3,866 feet. Fluid type is fresh gel. Resistivity values at bottom hole temperature 95°F. are R_m, 1.20; R_{mf}, 0.89, and R_{mc}, 1.60. Kelly bushing elevation is 7,573.

About the author

DR. WILLARD D. PYE *is professor of petroleum and geophysics, Department of Geology, University of Arizona, in Tucson, a post he has held since 1957. He was graduated from Oberlin College, Ohio with a B.A. degree in 1935. He received his M.S. and Ph.D. degrees from California Institute of Technology in 1937 and the University of Chicago in 1942, respectively. During World War II he was in charge of a chemical warfare research project in 1942-1943. His professional career includes posts as a geophysicist with Shell Oil Co. in 1936, geologist with Carter Oil Co., 1937-1940 and geologist with The Texas Company in the Rocky Mountains, 1943-1947. He has served as a consulting geologist and has been associated with numerous research and educational institutions during various periods since 1935. From 1947 to 1957 he was chairman and professor, Department of Geology and Geography, North Dakota Agricultural College, in Fargo. Dr. Pye has published widely on geological and geophysical subjects. He became a member of Phi Beta Kappa in 1935, and currently is a member of many professional groups, including SEPM, AAUP, GSA and Arizona Geological Society. He is a director of Arizona Oil and Gas Association of which he was president during 1965-1966.*

LITERATURE CITED

[1] Kornfeld, J. A. and Travis, M. M., "Arizona's Spectacular Oil Strike Tops Rocky Mountain Field Interest," *World Oil*, Vol. 164, No. 6, May 1967, pp. 189-190.

[2] O'Sullivan, R. B. and Beikman, H. M., Geology, Structure and Uranium Deposits of the Shiprock Quadrangle, New Mexico and Arizona, U.S. Geological Survey Miscellaneous Investigations Map I-345 (1963).

BIBLIOGRAPHY

Pye, W. D., "Arizona: a New Frontier to Explore," Interstate Oil Compact Commission Committee Bulletin, Vol. 8, 1966, pp. 37-39.

Brown, S. C. and Lauth, R. E., "Northern Arizona Has Good Oil, Gas Prospects," *World Oil*, Vol. 151, No. 4, Sept. 1960, pp. 93-106. ■

OIL AND GAS CONSERVATION COMMISSION

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June 27, 1967

The Attorney General
159 The Capitol
Phoenix, Arizona 85007

Attention: Mr. John McGowan
Mr. Jordan Green

Dear Sir:

Pursuant to your letter of June 7, 1967, the Commission has re-scheduled the Harless hearing for July 19, 1967 at 10:00 in the morning in the Commission hearing room, Room 204, 1624 W. Adams.

This letter is to request that you be present during this hearing.

Respectfully,

John Bannister
Executive Secretary
mr

June 27, 1967

Attorney General
159 The Capitol
Phoenix, Arizona 85007

Dear Sir:

The Oil and Gas Conservation Commission respectfully requests your opinion concerning ARS 27-522.B wherein it states the well records of a well drilled in unproven territory shall not be subject to inspection until six months after completion of the well.

As you are aware, a new field has been discovered on the Navajo Reservation. The operators of record have invoked the privilege of maintaining their information confidential under the quoted statute.

The Commission will hold a hearing on July 19, 1967 to consider the establishment of a proven pool in the area of the discoveries. Should the Commission establish this pool it would of course become proven territory.

The question the Commission [illegible] on is this: Once a territory has been declared by the Commission to be "proven" may the operator request that his information remain confidential?

Should your answer to the above questions have the effect of making the drilling records of a well completed in a proven territory public, what then would be the status of a well drilled prior to the declaration of a proven territory. In other words, does a well drilling or completed prior to the declaration cease to be confidential as of the date of the declaration, or will the confidential period still run in its entirety.

As we have indicated, this problem will come before the Commission on July 19, 1967 and we respectfully request your

answer to these questions in sufficient time to allow us to study your reply prior to that date. Your cooperation is greatly appreciated.

Very truly yours,

John Bannister
Executive Secretary
mr

July 13, 1967

Mr. Ralph W. Dilby
444 N. Camino Del Cento
Tucson, Arizona

Dear Mr. Dilby:

The staff joins me in extending our congratulations on your appointment as commissioner to the Oil and Gas Conservation Commission. We are looking forward to meeting you. Please be assured that if we may be of service, you have but to request it.

Your service starts at a critical time for the Commission in that due to the large discovery of oil on the Navajo Indian Reservation the work burden of both the staff and the Commission has greatly increased.

The Commission meets regularly on the third Wednesday of each month. The next meeting of the Commission is Wednesday, July 19, at 9:30 a.m. This meeting will be followed by two hearings, one at 10:00 a.m. and another at 1:30 p.m. It is unfortunate that your service will begin with such a burden.

We are enclosing the regular monthly reports of the executive secretary and the geologist, which are designed to keep you currently abreast of the affairs of the Commission. Inasmuch as much of the information is of confidential nature by law, and it is furnished to you as a commissioner, it is requested that you not reveal the information contained in these reports.

The Commission's offices are located in the center of the three Capitol office buildings on West Adams. I am sure you will have many questions which we will be glad to go into at your first opportunity.

Again, we are looking forward to meeting you, and be assured

we are willing to help you in any way in fulfilling your new position.

Most sincerely,

John Bannister
Executive Secretary
mr