OPEN FILE 84-9

ESTIMATED OIL AND GAS RESERVES FOR CHEYENNE COUNTY, COLORADO

Compiled by
A. H. Scanlon

Funded by the Department of Local Affairs--
Division of Commerce and Development

Colorado Geological Survey
Department of Natural Resources
State of Colorado
Denver, Colorado
1984

OPEN FILE 84-09

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Denver, Colorado
1984

Acknowledgments

I would like to thank the staff of the Colorado Oil & Gas Conservation Commission (C.O.G.C.C.) who provided considerable assistance during the course of this compilation, and the staff of the Colorado Geological Survey, who assisted in the manuscript preparation.

However, I assume full responsibility for any errors or omissions in these tabulations. Users of this OPEN-FILE REPORT could provide a significant service if they would inform the Colorado Geological Survey of any misinformation or omissions.

This project was completed by the staff of the Colorado Geological Survey as part of a grant from the Department of Local Affairs - Division of Commerce and Development.

A. H. Scanlon
Senior Geologist

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ESTIMATED OIL AND GAS RESERVES FOR CHEYENNE COUNTY, COLORADO

Introduction

This report is the seventh* in a series of oil and gas reserve investigations undertaken for those counties in which oil and/or gas is currently being produced.

This study involves Cheyenne County, located in east central Colorado, approximately 100 miles due east of Colorado Springs, straddling the Las Animas Arch. Cheyenne County covers 1,772 square miles. In this county, oil and/or gas are produced from, in descending order of age, the Topeka (Shawnee) Carbonate, Marmaton Limestone, Morrowan Sandstone and Mississippian-Spergen Limestone.

There are 15 fields considered active producers as of September 30, 1983. Of these, 14 are classified as oil fields (based on cumulative gas-oil ratio (GOR) of <15:1), and 1 is classified as a gas field (based on cumulative GOR >15:1).

* Refer to:
OPEN-FILE REPORT 84-3: Estimated Oil and Gas Reserves for Washington County, Colorado;
OPEN-FILE REPORT 84-4: Estimated Oil and Gas Reserves for Rio Blanco County, Colorado;
OPEN-FILE REPORT 84-5: Estimated Oil and Gas Reserves for Adams County, Colorado;
OPEN-FILE REPORT 84-6: Estimated Oil and Gas Reserves for Weld County, Colorado;
OPEN-FILE REPORT 84-7: Estimated Oil and Gas Reserves for Arapahoe County, Colorado; and
OPEN-FILE REPORT 84-8: Estimated Oil and Gas Reserves for Baca County, Colorado.

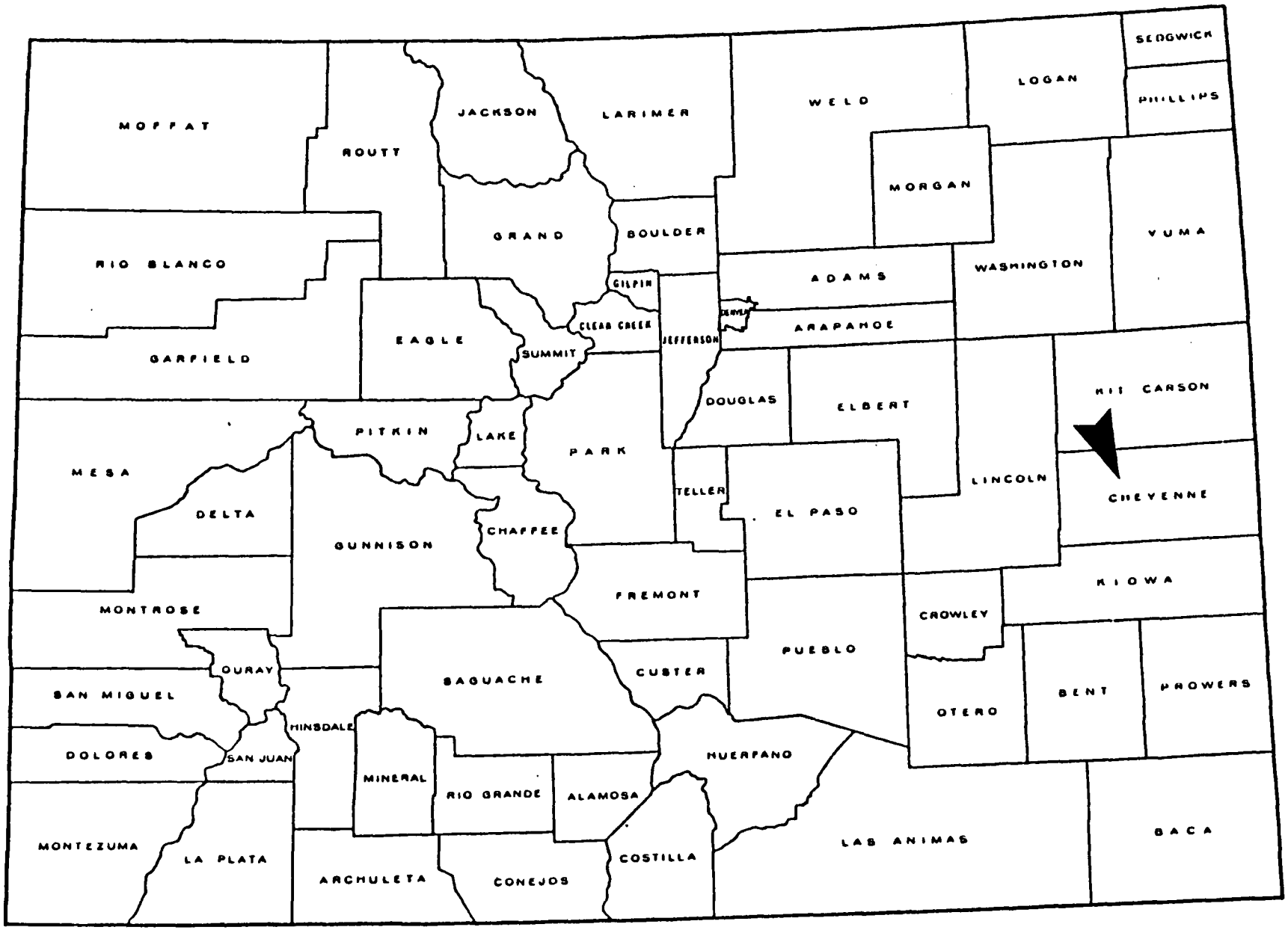


Figure 1. County Location Map

Method of Approach

Production decline curves are plotted for each currently producing horizon within each field, hereafter referred to as a field-horizon. There are 22 production decline curves plotted, one for each field-horizon. Production data were obtained from the C.O.G.C.C. annual production books. These books contain records of yearly production data, dating back to 1952. All production decline curves are plotted as rate (annual production in barrels of oil or MCF of gas) versus time (in years). The rate scale was adjusted to accommodate each field-horizon.

Oil Reserve Calculations

There are 21 oil field-horizons. Production histories have allowed for decline rates to be calculated for 8 of these. The remaining 13 oil field-horizons have not produced for a long enough time (less than 4 years) to determine a reliable decline rate. For the previously mentioned 8 fields, decline rates were determined based on actual past production and recorded, see Table II. These decline rates were then applied to the equation:

$$Rr = \frac{q1 - qf}{-\ln (1-dy)}$$

where: Rr = remaining reserves
q1 = current annual production
qf = final economic production rate (see note below.)
-ln = negative natural log
dy = yearly decline rate (in percent)

The ultimate recoverable was then determined by adding the estimated reserves to the cumulative production. These values are listed in Table I.

Note: the final economic production rate used was one barrel of oil per day per well, for one year; therefore 365 barrels, multiplied by the number of wells needed to keep field production economic. In most cases this was one well. The number of wells used was determined at the discretion of the author.

For associated gas production, estimated reserves were calculated in the same manner as that described in the Gas Reserve Calculations section.

Gas Reserve Calculations

There is one gas field-horizon. Production history from the Arapahoe-Morrowan field-horizon has been too short for a decline rate to be calculated. In addition, production from this field-horizon has been shut-in as of 9-30-83. Therefore, no gas reserve figure was calculated for this gas field-horizon.

For associated gas production from oil field-horizons, decline rates were determined based on past production and applied to the equation:

$$S = \frac{a(1-r^n)}{1-r}$$

Where: S = gas reserves
a = current annual gas production
r = (1-dy) where dy = annual decline rate
n = number of years -- 20 years was used in all cases except where noted in the remarks column of Table I.

Results can be found in Table I.

For the associated oil production, there this production was significant, the same method to determine estimated oil reserves was used, as discussed in the previous section. Whether oil production was considered significant of not was determined by the author. In all cases, if oil production indicated any kind of trend, reserves were calculated. A few cases arose where oil production, though a trend was indicated, did not exceed the economic limit (as discussed previously) of one barrel of oil per day per year, and therefore no reserve estimate was calculated, or an economic limit of zero was used.

Results

The following figures are for those field-horizons for which reserves could be calculated. Estimated oil reserves for Cheyenne County totaled 11,742,162 barrels. Estimated gas reserves for Cheyenne County totaled 33,837 MCF. Note that the gas reserve calculations are based on a 20-year projection, therefore they do not account for gas production after the year 2002.

These figures also do not account for production increases due to secondary and/or tertiary recovery not already in progress, or account for undiscovered reserves, nor do they reflect changes in economics or demand.

In seven to eight years, roughly half of the estimated oil reserves in Cheyenne County will have been produced. Roughly one half of the estimated gas reserves for the next 20-year period are expected to be produced in six to seven years.

In this county there are two classes of field-horizons: I) those with a long enough production history to calculate reserves with confidence, and II) those new field-horizons with essentially no production history, or for other reasons, reserves cannot be calculated.

To be able to calculate total county oil and gas reserves, it was necessary to apply the overall decline rates (8.15 percent per year for oil and 7.4 percent per year for gas) obtained from class I field-horizons to the current production from Class II field-horizons.

Using this approach on current production from Class II field-horizons (446,810 Bbls. of oil and 364,487 MCF of gas) additional reserves of 5,199,946 Bbls. of oil and 3,864,051 MCF of gas were obtained. This gives total county reserves (Class I and II) of 16,942,108 Bbls. of oil and 3,900,888 MCF of gas.

To insure that the reserve figures calculated for Class II are reasonable using this method, a comparison was made between the sources (producing horizons) of the Class I and Class II field-horizons. It was determined that there were some differences in the sources of production for the two groups. Therefore, it is concluded that the overall decline rates can be applied with confidence. The gas production source from Class II field-horizons does not compare well with gas production source from Class I field-horizons. The most significant difference stems from Sorrento Field-Morrow production. Gas from the Morrow has not been produced for a long enough time to obtain a decline rate with confidence. As the overall gas decline rate of 7.4 percent is not unusually high or low it is applied here with some confidence to Sorrento-Morrow gas production, as reflected in the Class II reserve figure.

LIST OF ABBREVIATIONS USED IN TABLE OF RESERVE DATA

'a'	annual gas production
ABD.	abandoned
Approx.	approximate, approximately
Avg.	average, averaged
Bbls.	barrels
B.W.E.	Bottom Water Encrochment
calc.	calculate, calculated
Co.(s)	county (counties)
cond.	condensate
ck.	Creek
Cum.	cumulative
Dak.	Dakota Sandstone
Deplet.	Depletion
dy	annual decline rate
Econ.	Economic
Est.	Estimated
Exp.	Expansion
g	gas
Gas Exp.	Gas Expansion
G.C.E.	Gas Cap Expansion
G.E.	Gas Expansion
GOR	Gas-Oil Ratio
Inc.	Increase, increasing, increased
Inj.	Injection, injected
Lmtd.	Limited
MCF	Thousand cubic feet
Miss.	Mississippian
Mos.	Months
Mtn.	Mountain
N	North
N.P.	New Production or less than five years production, therefore, no reliable annual decline rate could be calculated to apply to the equations to calculate reserves.
No.	number, numbers, North
o	oil
P and A	Plug (ged) and Abandon (ed)
Poss.	Possible
Prod.	Production, produced
Proj.	Projection, projected
q	current annual production of oil
qf	final economic production of oil
react.	reactivated
Rr	Remaining reserves-oil
S	Remaining reserves-gas
S.G.D.	Solution Gas Drive
S.I.(SI)	Shut-in
So	South
W	West
W.D.	Water Drive
Yr or Yrs	Year or years

TABLE I
OPEN FILE 84-9
RESERVE DATA FOR CHEYENNE COUNTY

FIELD NAME/ PRODUCING HORIZON	LOCATION	DATE OF DISCOVERY	TYPE OF DRIVE	Dy	CUMULATIVE PRODUCTION 12/31/82		ESTIMATED RESERVES		ULTIMATE RECOVERABLE		REMARKS
					OIL (Bbls.) ()Condensate (Bbls.)	GAS (MCF)	OIL (Bbls.)	GAS (MCF)	OIL (Bbls.) ()Condensate (Bbls.)	GAS (MCF)	
1.Arapahoe/Morrow	14S-42W	1978			21,977 (2570)	1,108,355					SI 9/83
2.Archer/ Mississippian	12S-44W	1981	W. D.		148,888						N.P.
3.Archer/Shawnee	12S-44W	1981			30,843						N.P.
4.Archer/Topeka	12S-44W	1981			30,744						N.P.
5.Broken Bow/ Mississippian (Spergen)	13S-44W	1977		11.5 -o	60,561		33,356		93,917		
6.Cheyenne Wells/ Topeka (Shawnee)	14S-44W	1973	W. D.	7.5 -o	203,713		128,987		332,700		
7.Cheyenne Wells/ Mississippian	14S-44W	1968	S. G. D.		1,824,725	18,232					
8.Dust Bowl/ Marmaton	16S-46W	1982			456						N.P.
9.Golden Spike/ Mississippian	16S-45W	1969	B. W. E.	8.4 -o	1,429,123	250	536,569		1,965,692	+250	
10.Gopher/Morrow	16S-45W	1982			2,337						N.P.
11.Grouse/Miss. (Spergen)	15S-46W	1981	W. D.		178,766	85					N.P.
12.Grouse/Morrow	15S-46W	1979	W. D.		85,378	3,674					SI 9/83
13.Ladder Creek/ Miss.(Spergen)	14&15S-44&45W	1969	B. W. E.	5.6 -o 6.8 -g	1,387,979	145,571	728,503	31,897	2,116,482	177,248	Econ.Limit 2 wells
14.Loma/ Mississippian	16S-45W	1969		10.3 -o	90,423		113,947		204,370		Prod.'69, '77-'83
15.Pass Creek/ Marmaton	16S-45W	1982			72						N.P.
16.Salis/Shawnee	16S-45W	1982			1,723						N.P.
17.Smokey Creek/ Miss.(Spergen)	13S-44W	1969	S. G. D.	9.9 -o	1,049,335		393,727		1,443,062		
18.Sorrento/ Marmaton	13S-49W	1980	G. C. E. + S. G. D.		9,760	1,101					SI 9/83
19.Sorrento/ Mississippian (Spergen)	13S-49W	1976	G. C. E. + S. G. D.	11.5 -o 15.7 -g	32,998	23,731	24,982	1,940	57,980	25,671	
20.Sorrento/ Morrow	13S-49W	1979	G. C. E. + S. G. D.	8.1 -o	2,088,447	638,710	9,782,091	See Remarks	11,870,538	638,710	Econ.Limit= 5 wells;
21.Spur/ Mississippian	14S-44W	1981			81,996						N.P.
22.Spur/Shawnee	14S-44W	1982			1,327						N.P.
COUNTY TOTAL OF ESTIMATED RESERVES						11,742,162 Bbls.	33,837 MCF				

Reference List

Colorado Oil and Gas Conservation Commission Production Records and Injected Fluids - Water and/or Gas-File.

Crouch, M.C., III, editor, 1982 Oil and Gas Fields of Colorado, Nebraska and Adjacent Areas: Rocky Mountain Association of Geologists, vols. I and II, 791 pp.

Haun, J.D., Cardwell, A.L., Herrod, W.H. and Cronoble, J.M., 1976. Oil and Gas Reserves of Colorado in Colorado School of Mines Research Institute, Mineral Industries Bulletin, v. 19, #5.

Parker, J.M., editor, 1961 Oil and Gas Field volume: Colorado-Nebraska: Rocky Mountain Association of Geologists, 389 pp.

Appendix I

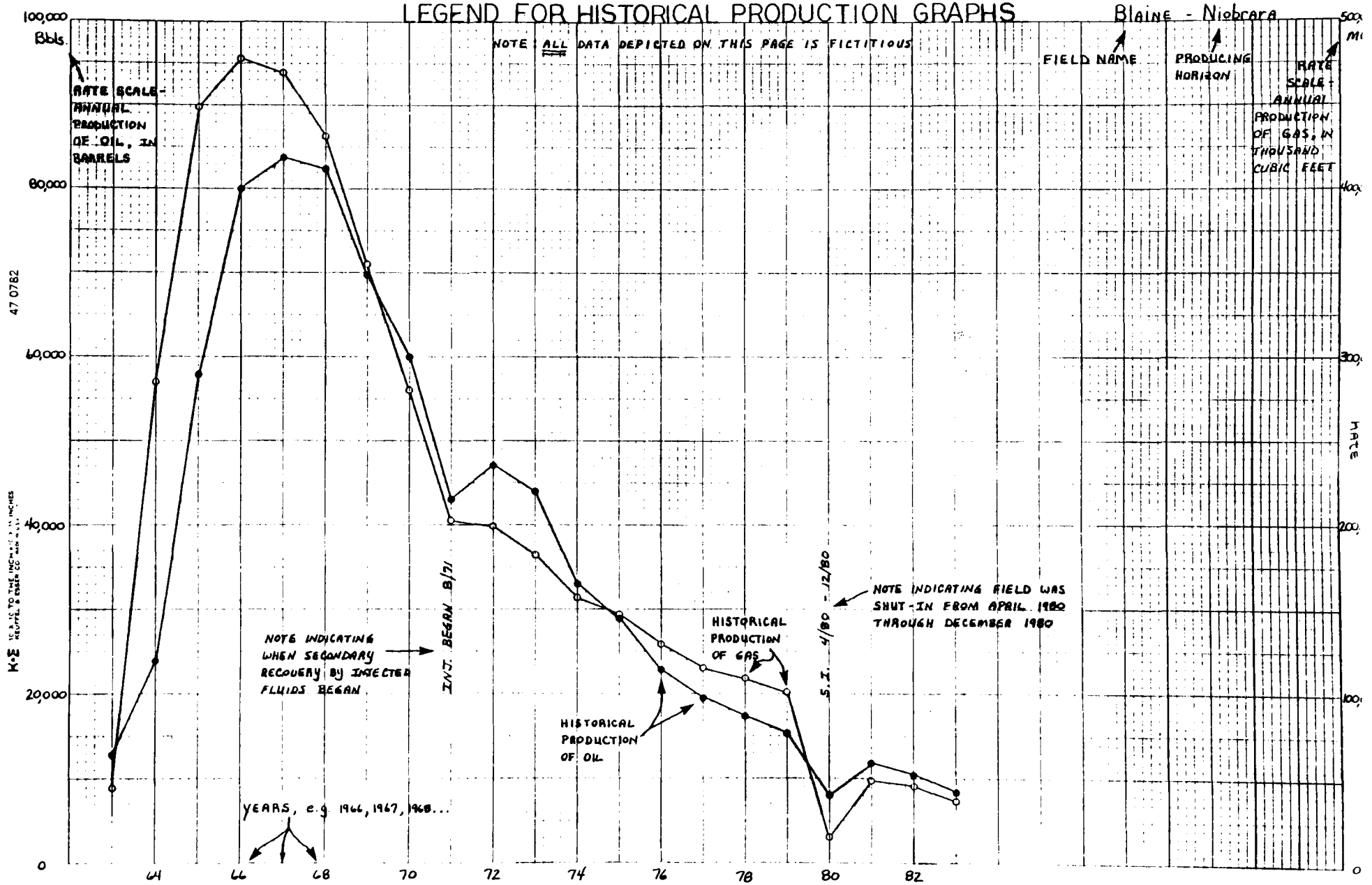
Historical production decline curve graphs for Cheyenne County. These graphs are presented in alphabetical order by Field name and then by producing horizons within each field.

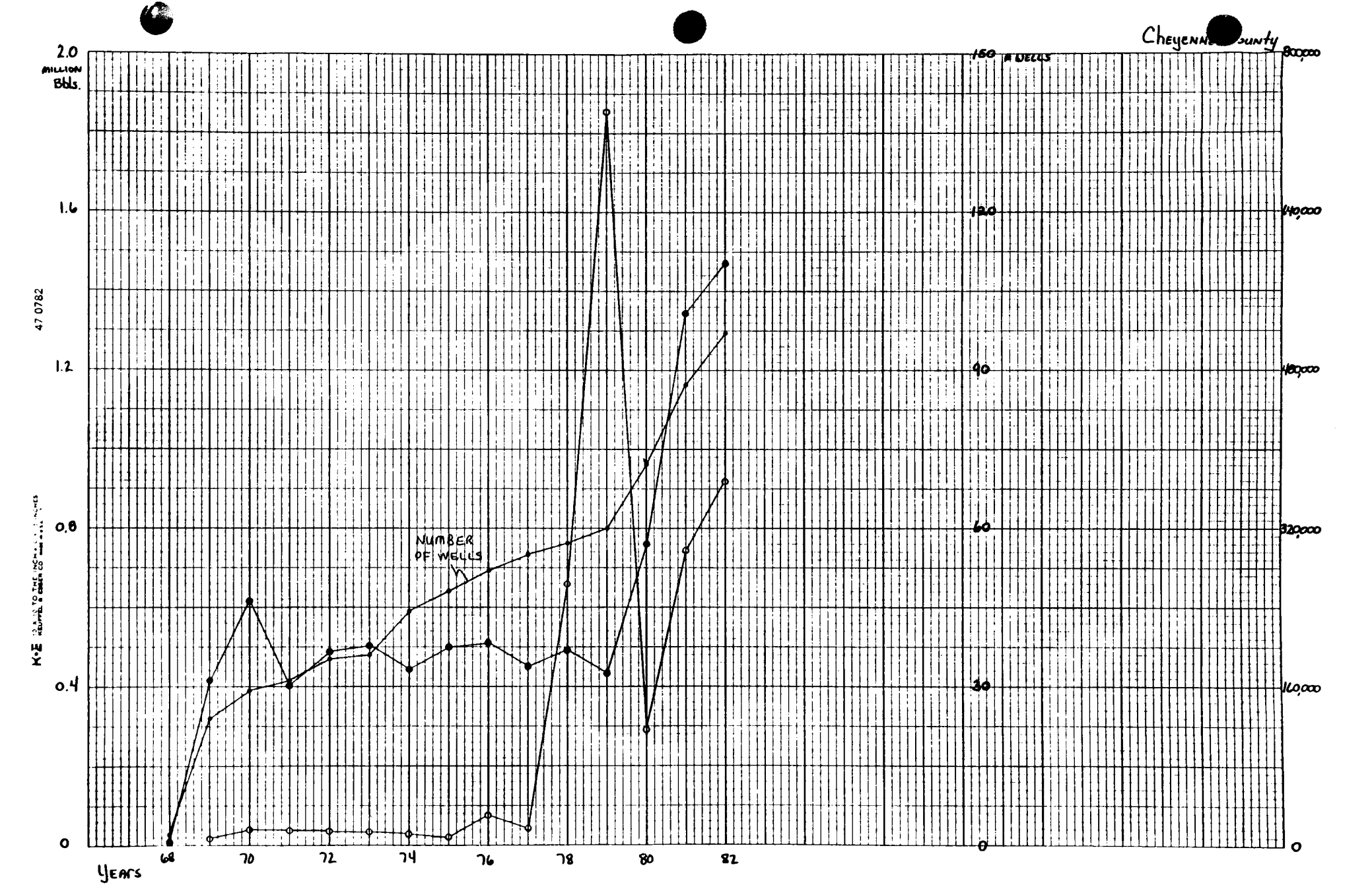
Note that only those fields actively producing as of 9-30-83 are included. Abandoned fields or field-horizons are not included.

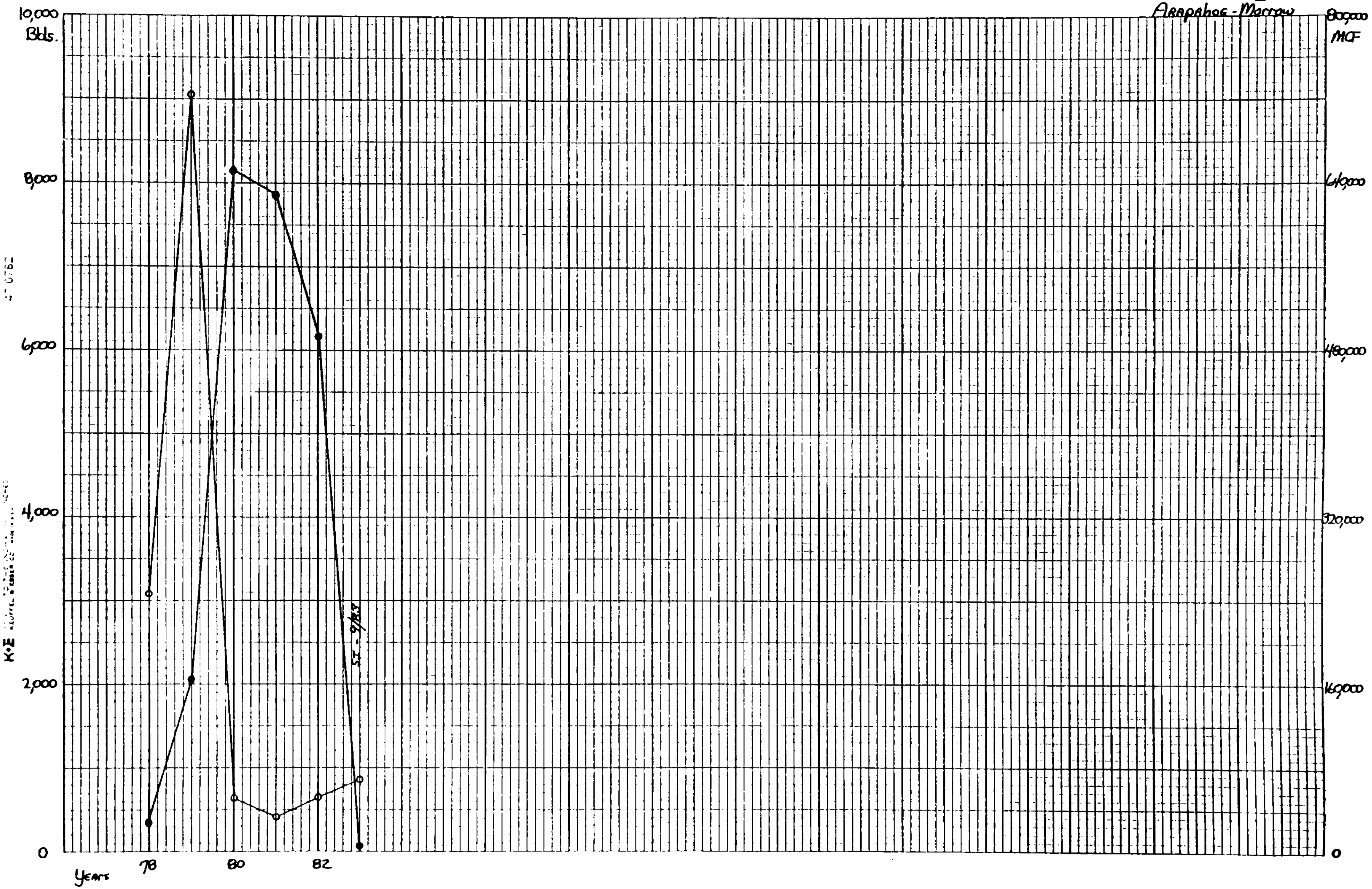
LEGEND FOR HISTORICAL PRODUCTION GRAPHS

Blaine - Niobrara

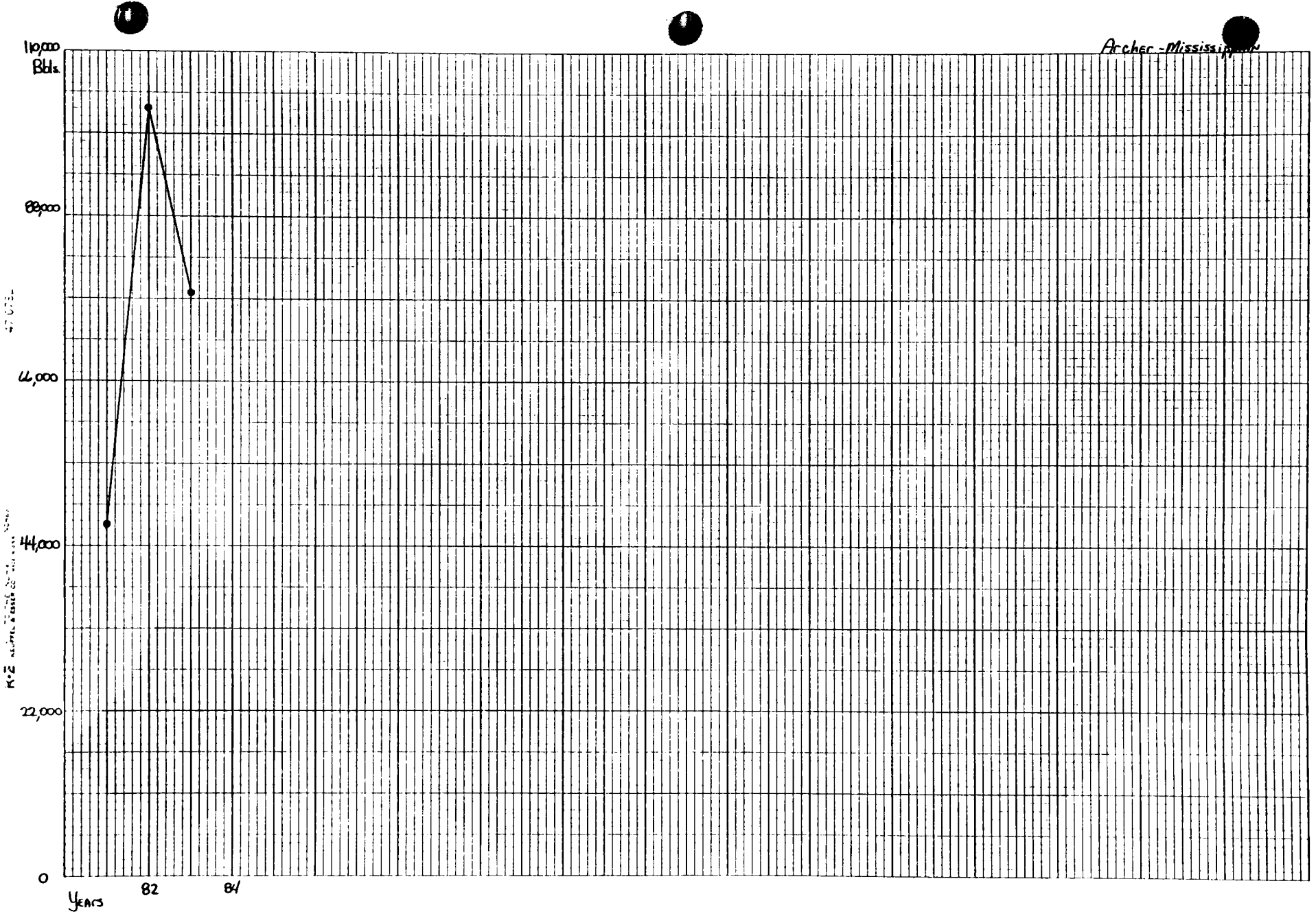
NOTE: ALL DATA DEPICTED ON THIS PAGE IS FICTITIOUS

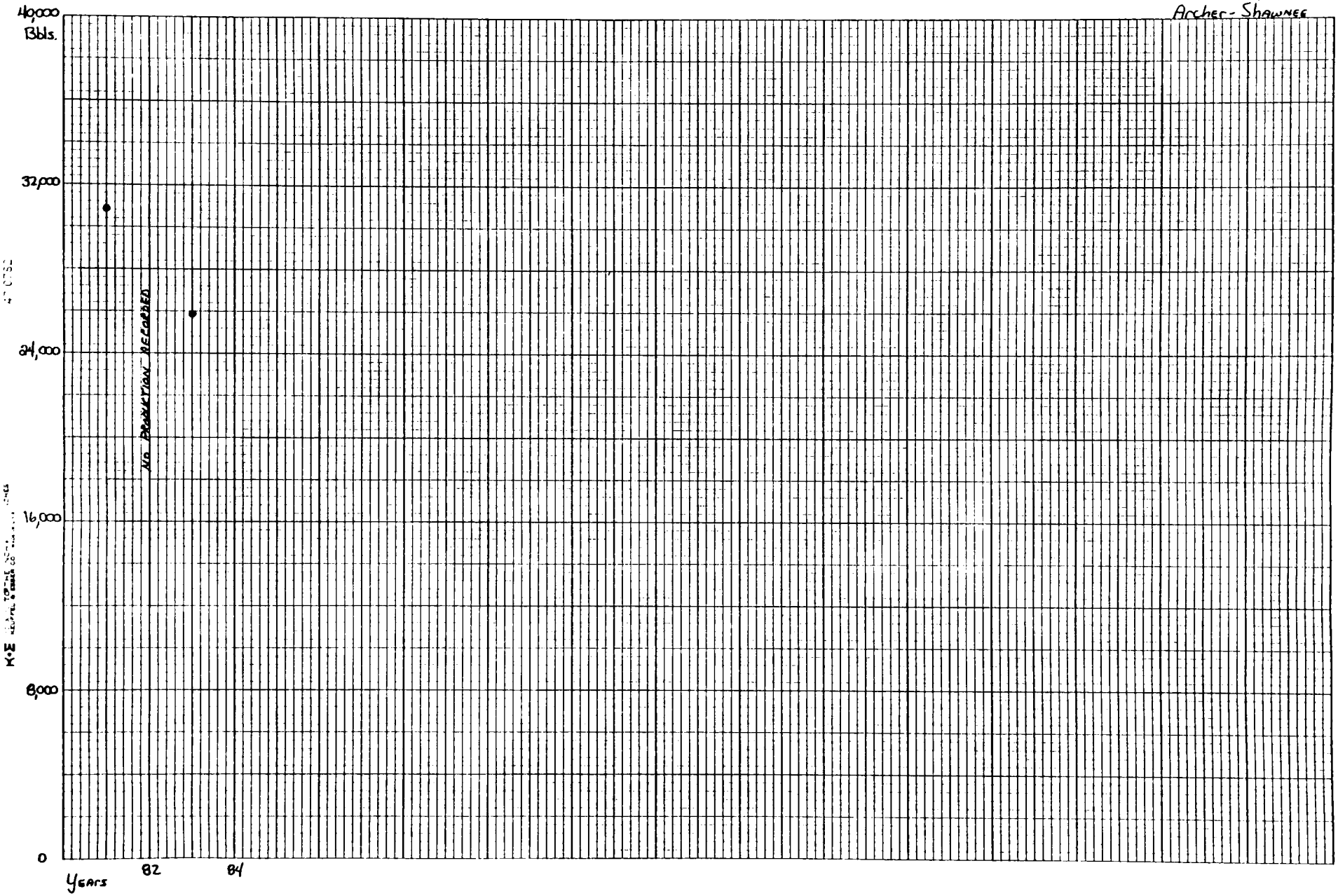


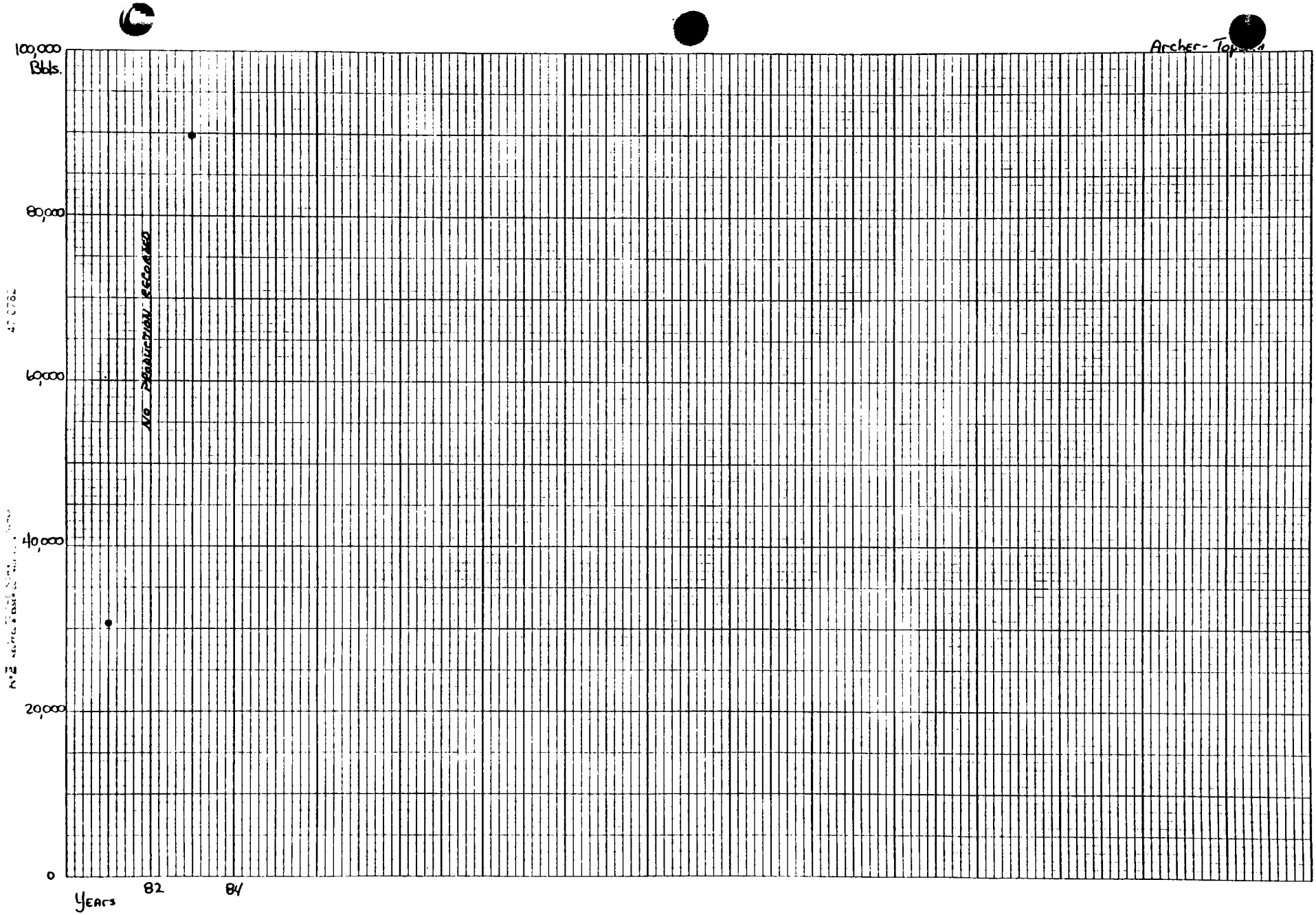

Cheyenne County
2.0
MILLION
Bbls.
1.6
1.2
0.8
0.4
0
160 # WELLS
120
80
40
0
800,000
640,000
480,000
320,000
160,000
0
NUMBER
OF WELLS
68
70
72
74
76
78
80
82
YEARS
47 0782
K+E

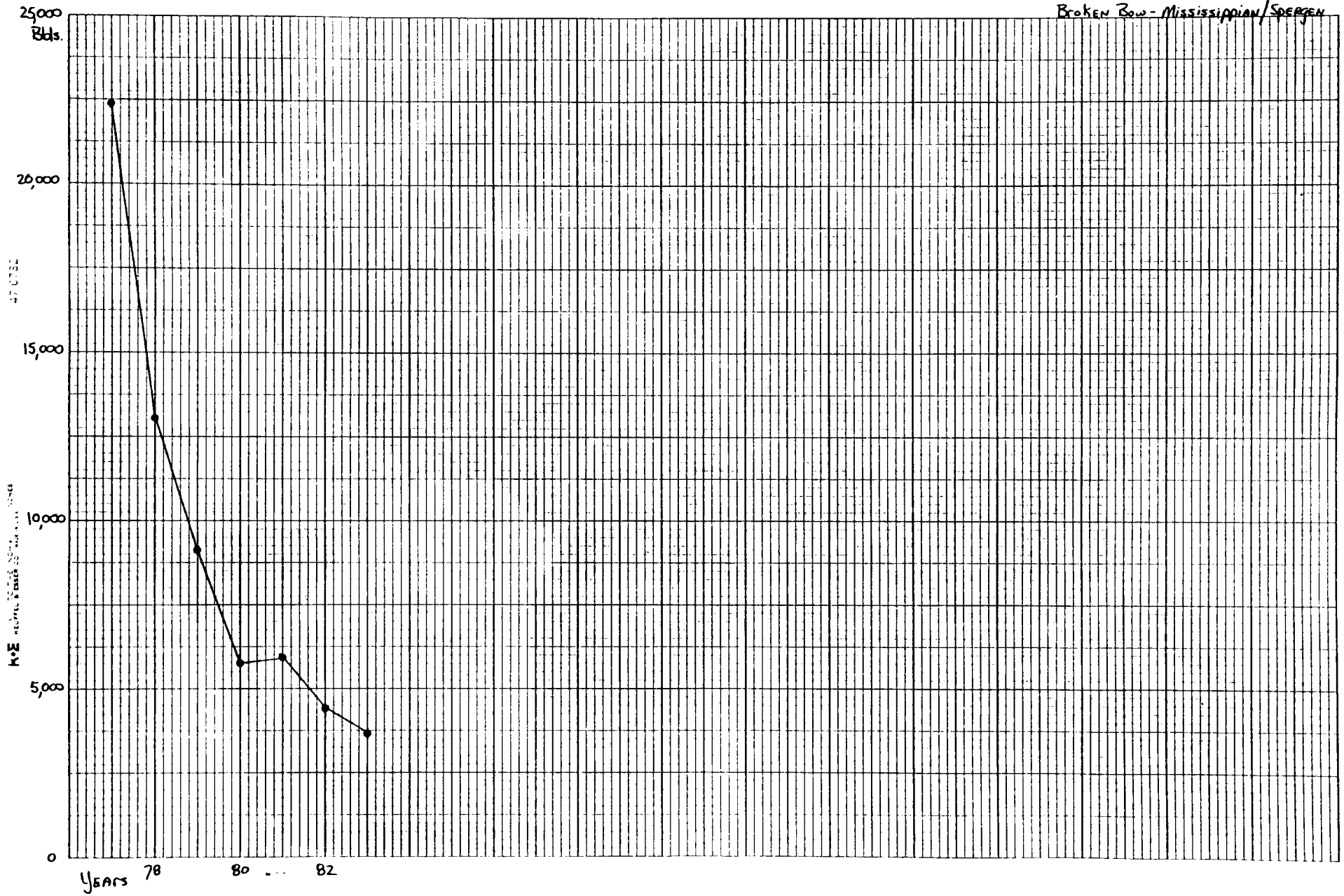


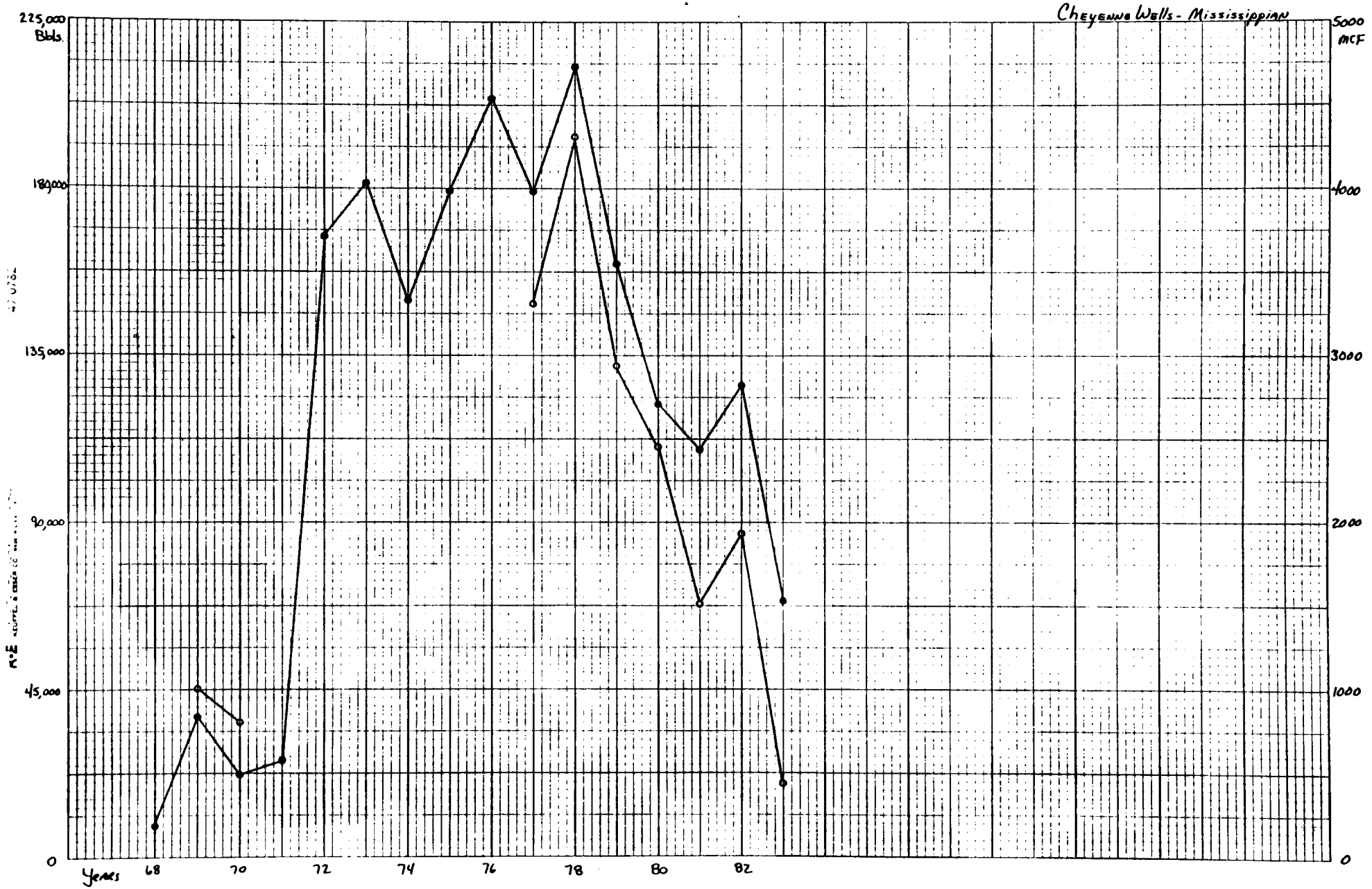
Arapahoe-Morrow
10,000
Bbls.
8,000
6,000
4,000
2,000
0
800,000
MCF
640,000
480,000
320,000
160,000
0
78
80
82
Years
SI - 9/83

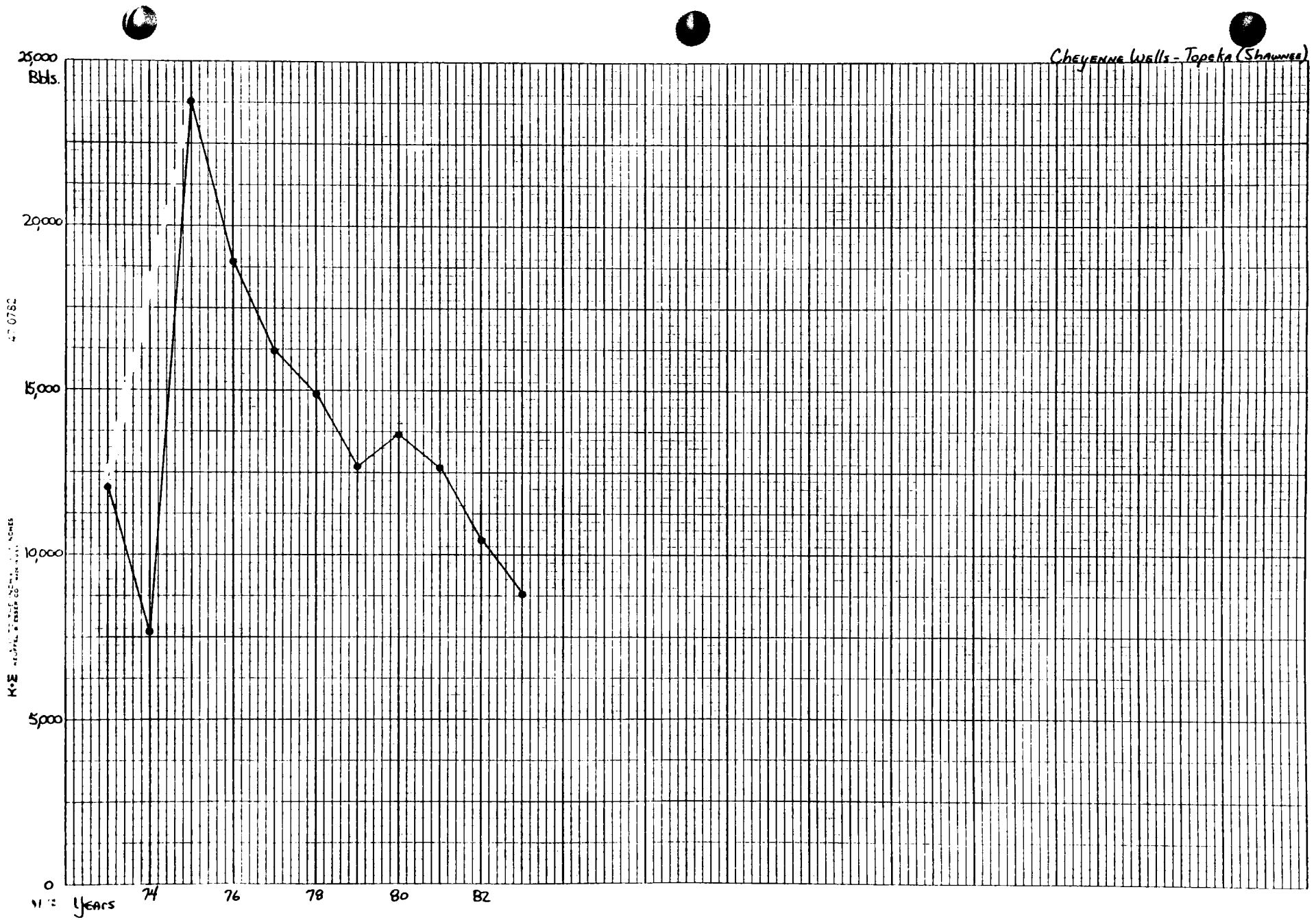

Archer - Mississippi
110,000
Bbls.
88,000
66,000
44,000
22,000
0
82
84
Years


Archer-Shawnee
40,000
Bbls.
32,000
24,000
16,000
8,000
0
No Production Recorded
82
84
Years

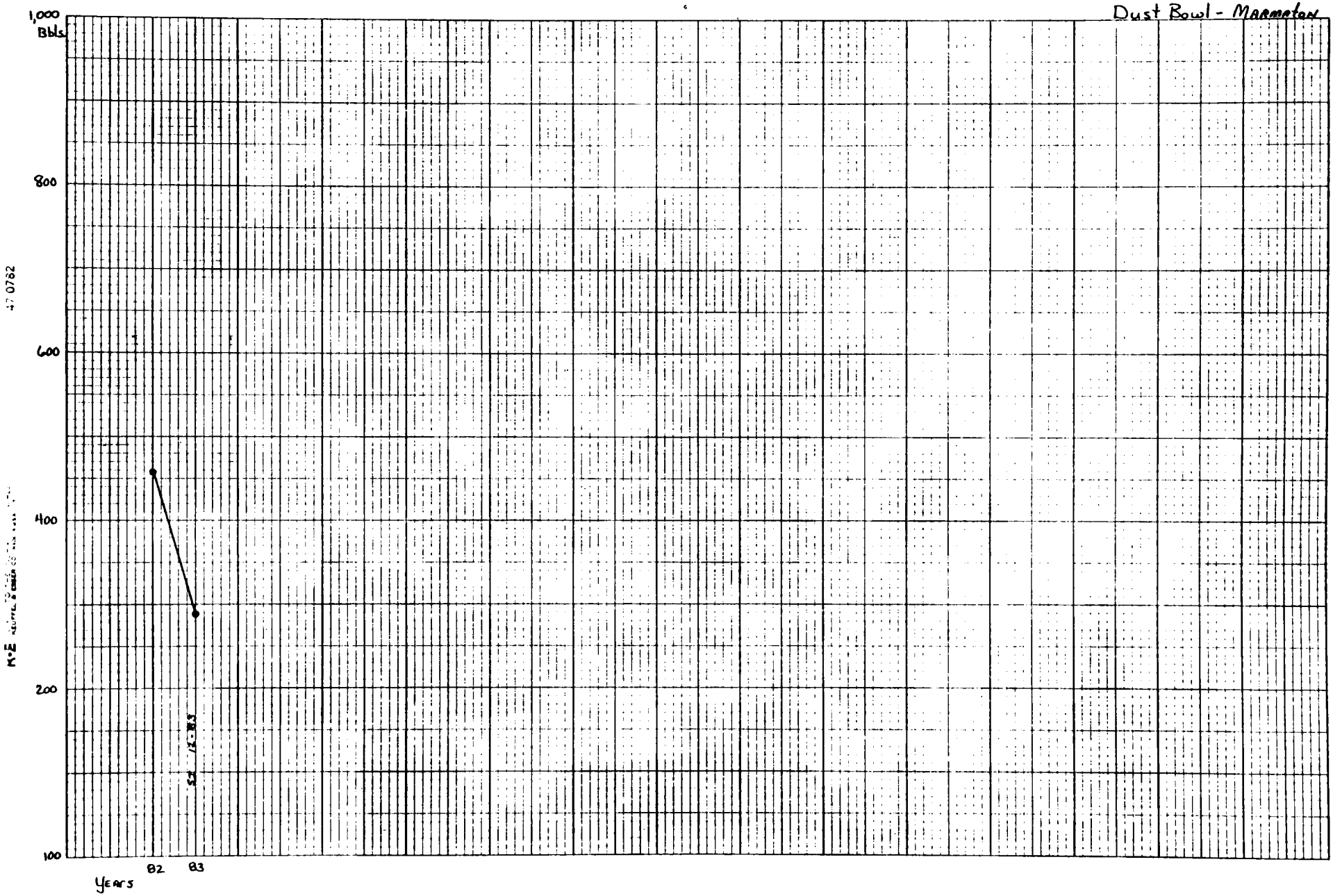

100,000
Bbls.
80,000
60,000
40,000
20,000
0
82
84
Years
Archer-Top
No Production Recorded


Broken Bow - Mississippian/Spergen
25,000
Bbls.
20,000
15,000
10,000
5,000
0
Years
78
80
82

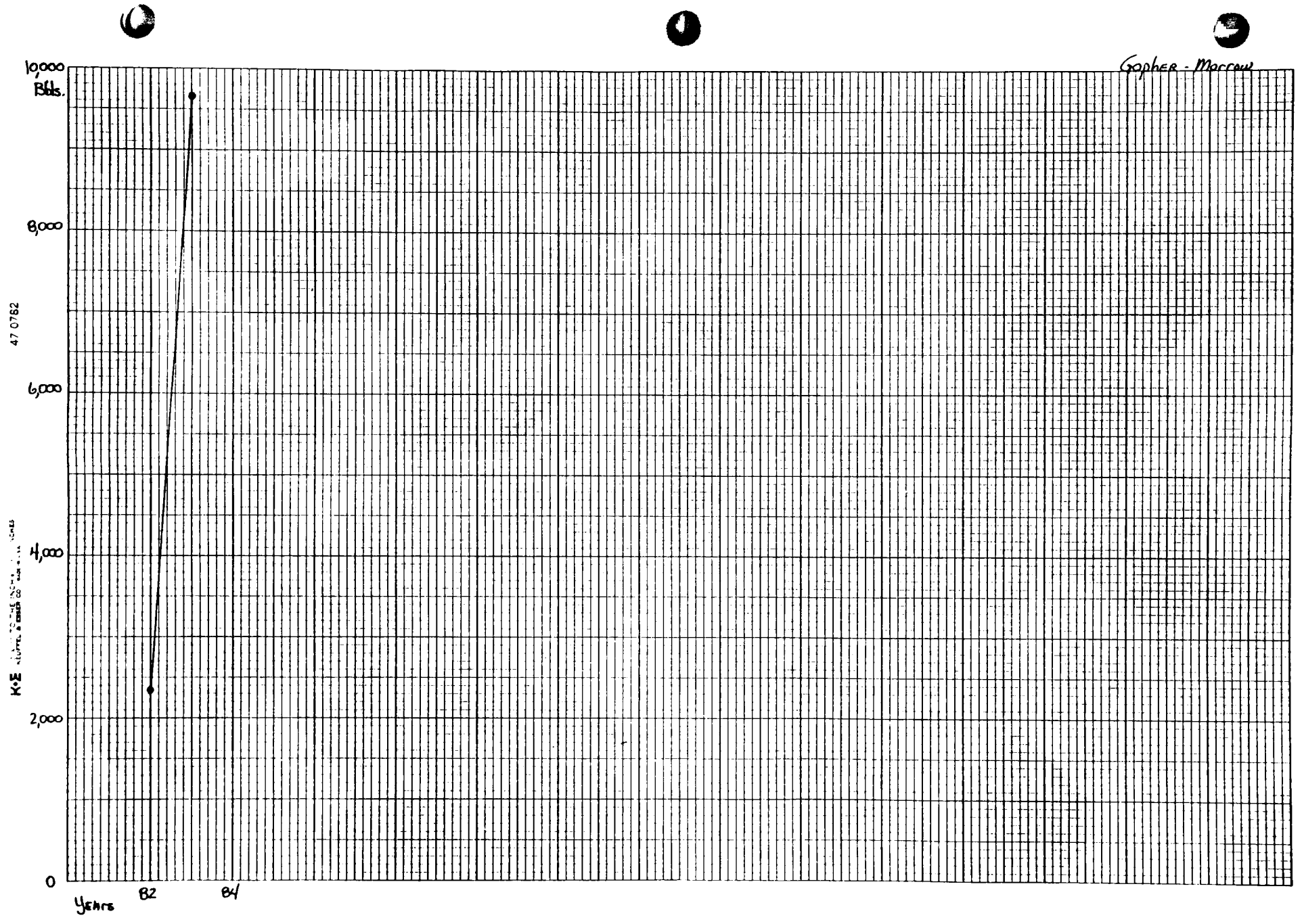

Cheyenne Wells - Mississippian
225,000 Bbls.
180,000
135,000
90,000
45,000
0
5000 MCF
4000
3000
2000
1000
0
Years
68
70
72
74
76
78
80
82

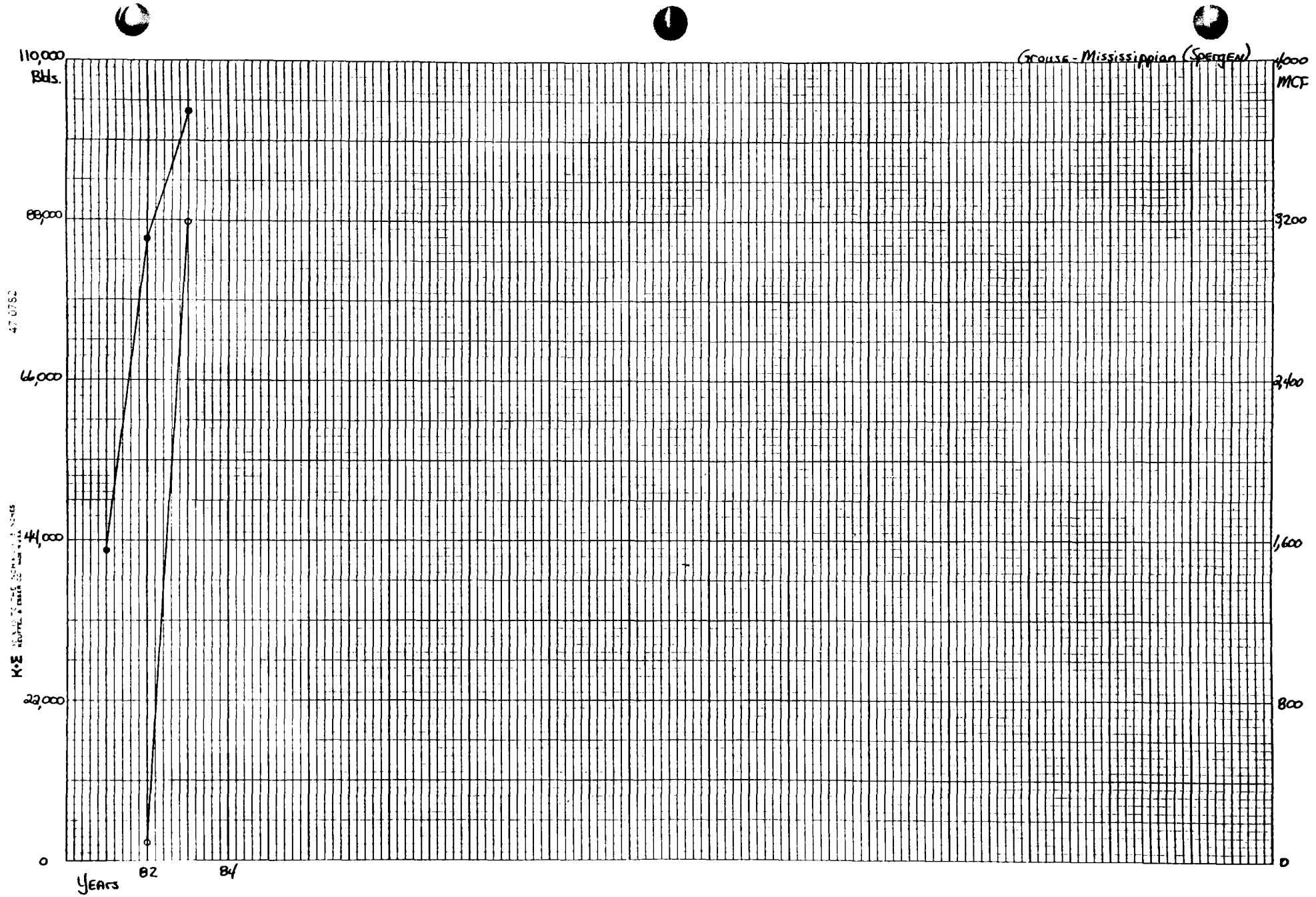

Cheyenne Wells - Topeka (Shawnee)
25,000
Bbls.
20,000
15,000
10,000
5,000
0
74
76
78
80
82
Years

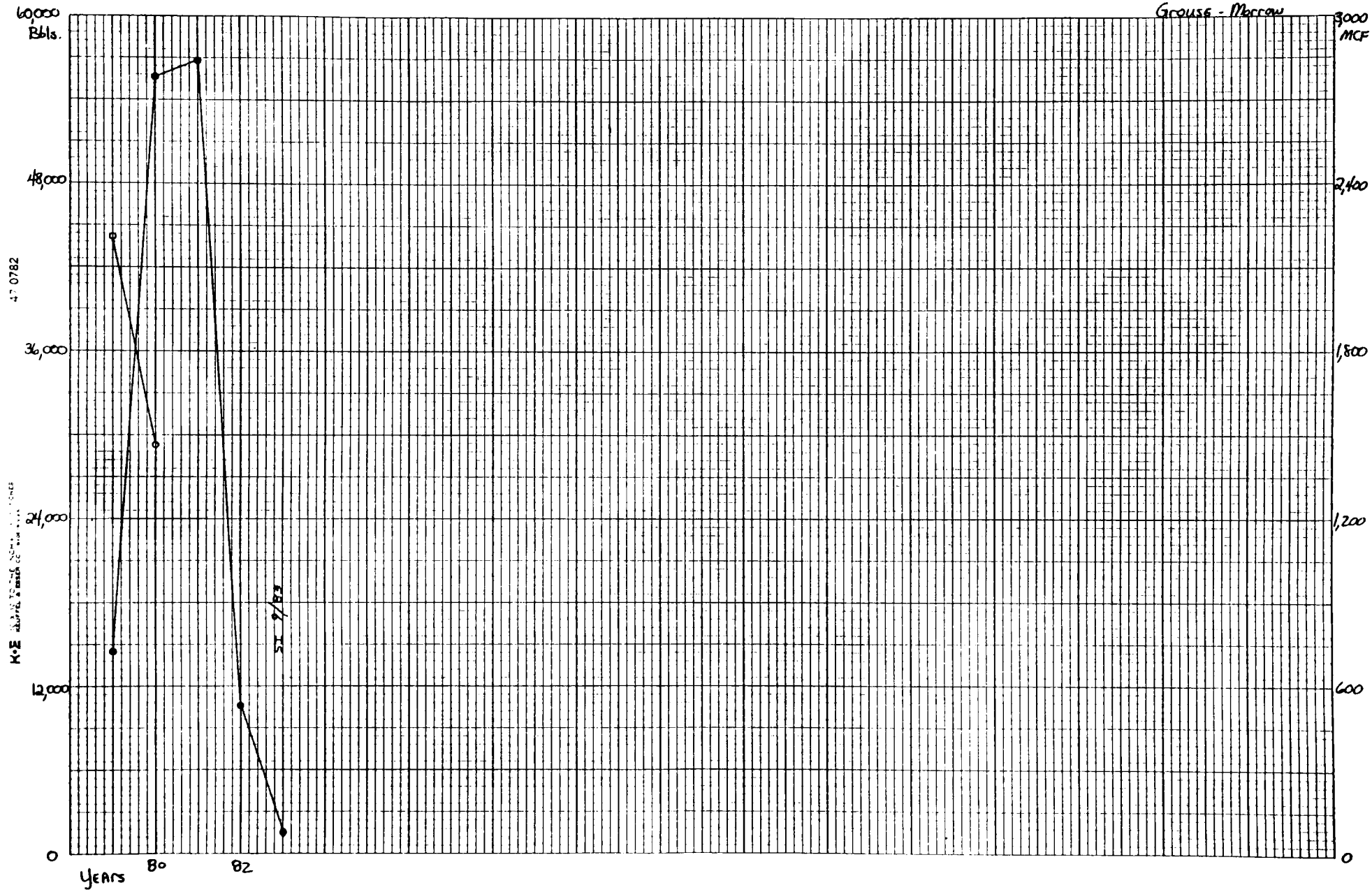
Dust Bowl - Marmaton

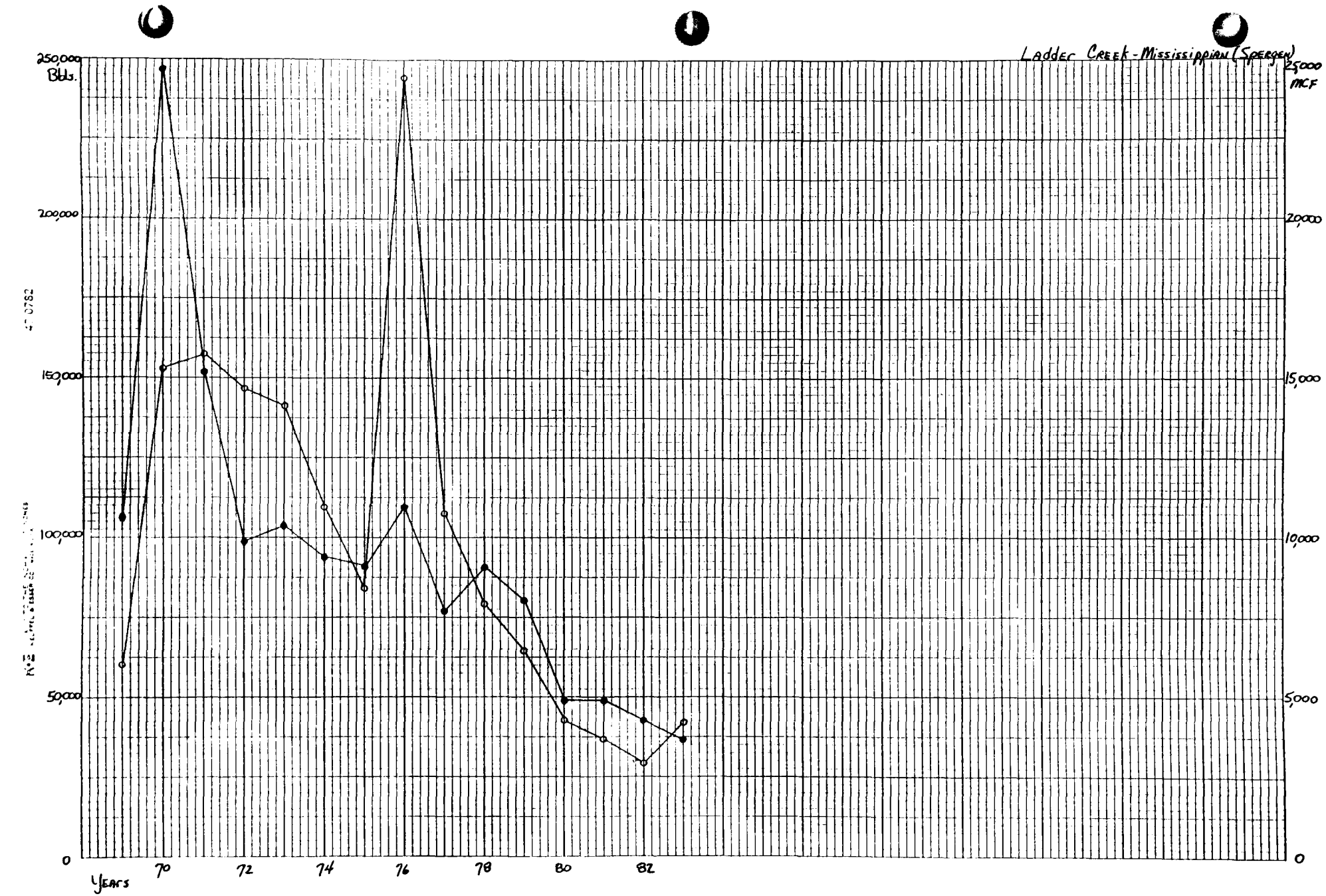


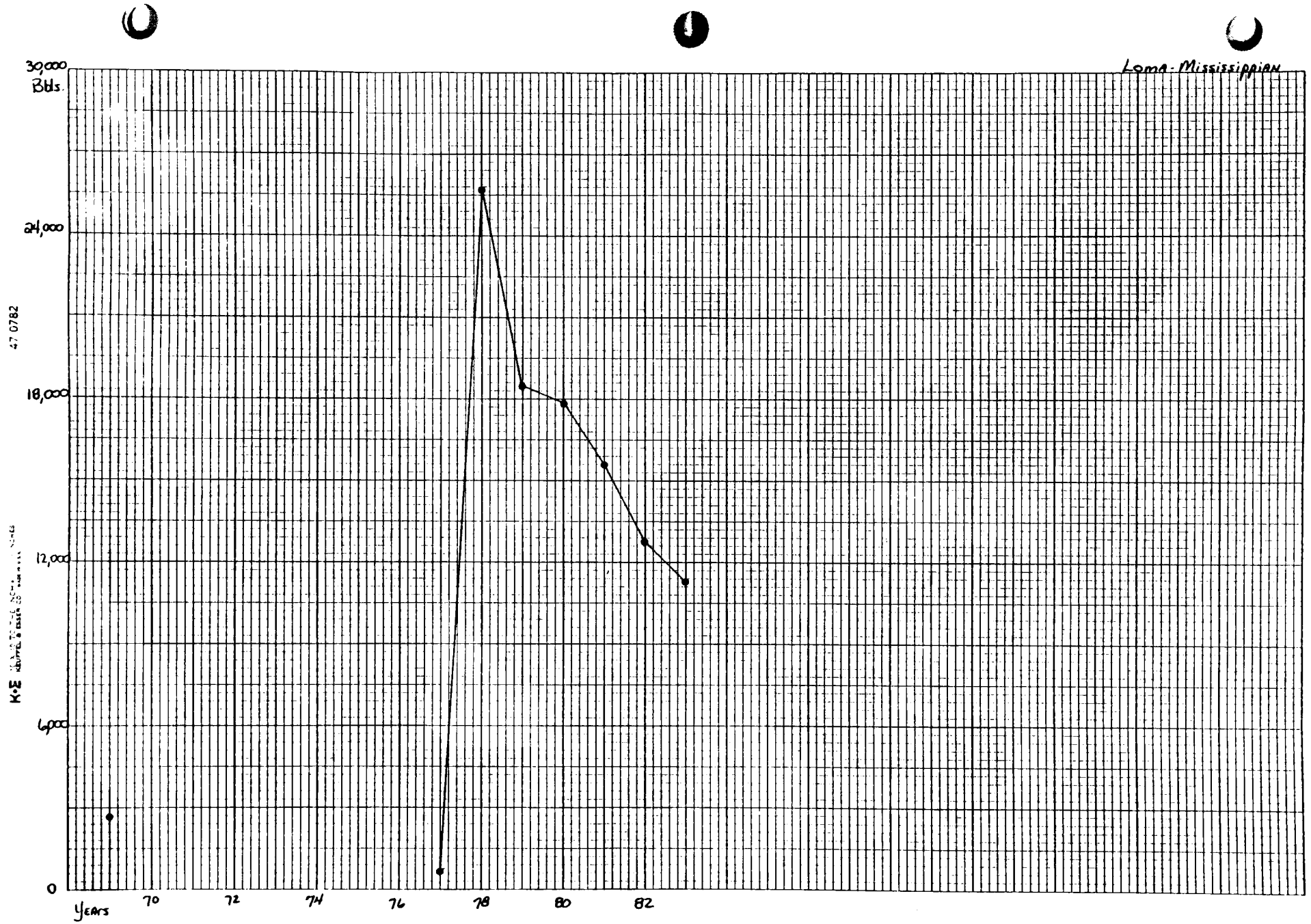

Golden Spike - Mississippian
300,000
Bbls.
240,000
180,000
120,000
60,000
0
Years
70
72
74
76
78
80
82

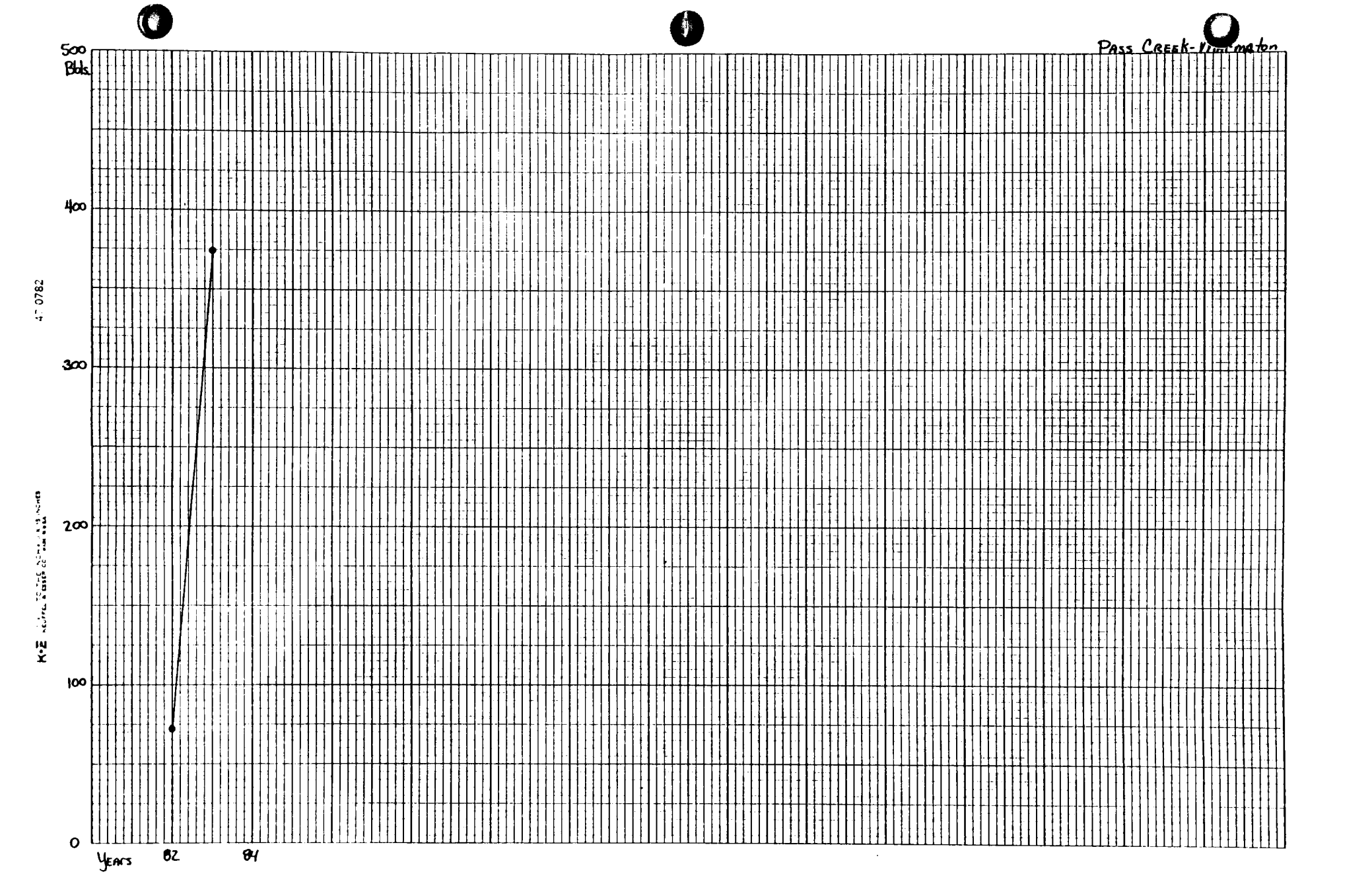

Gopher - Morrow
10,000
Bbls.
8,000
6,000
4,000
2,000
0
Years
82
84
47 0782
K•E

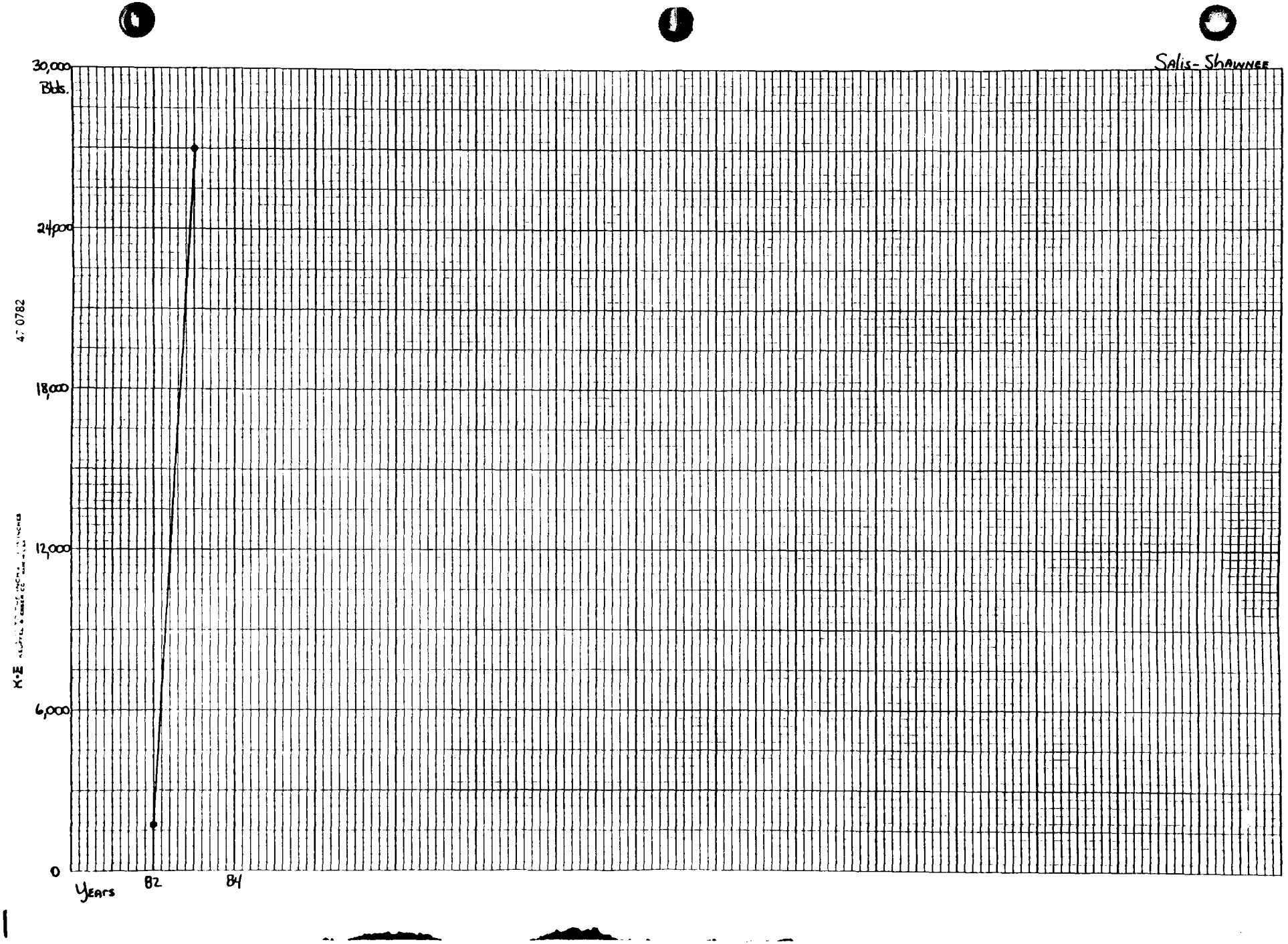

Grouse - Mississippian (Spergen)
110,000
Bbls.
88,000
66,000
44,000
22,000
0
4000
MCF
3200
2400
1600
800
0
Years
82
84
47 0750
K·E


Grouse - Morrow
60,000 Bbls.
48,000
36,000
24,000
12,000
0
3,000 MCF
2,400
1,800
1,200
600
0
Years
80
82
SI 9/83
47 0782
K·E

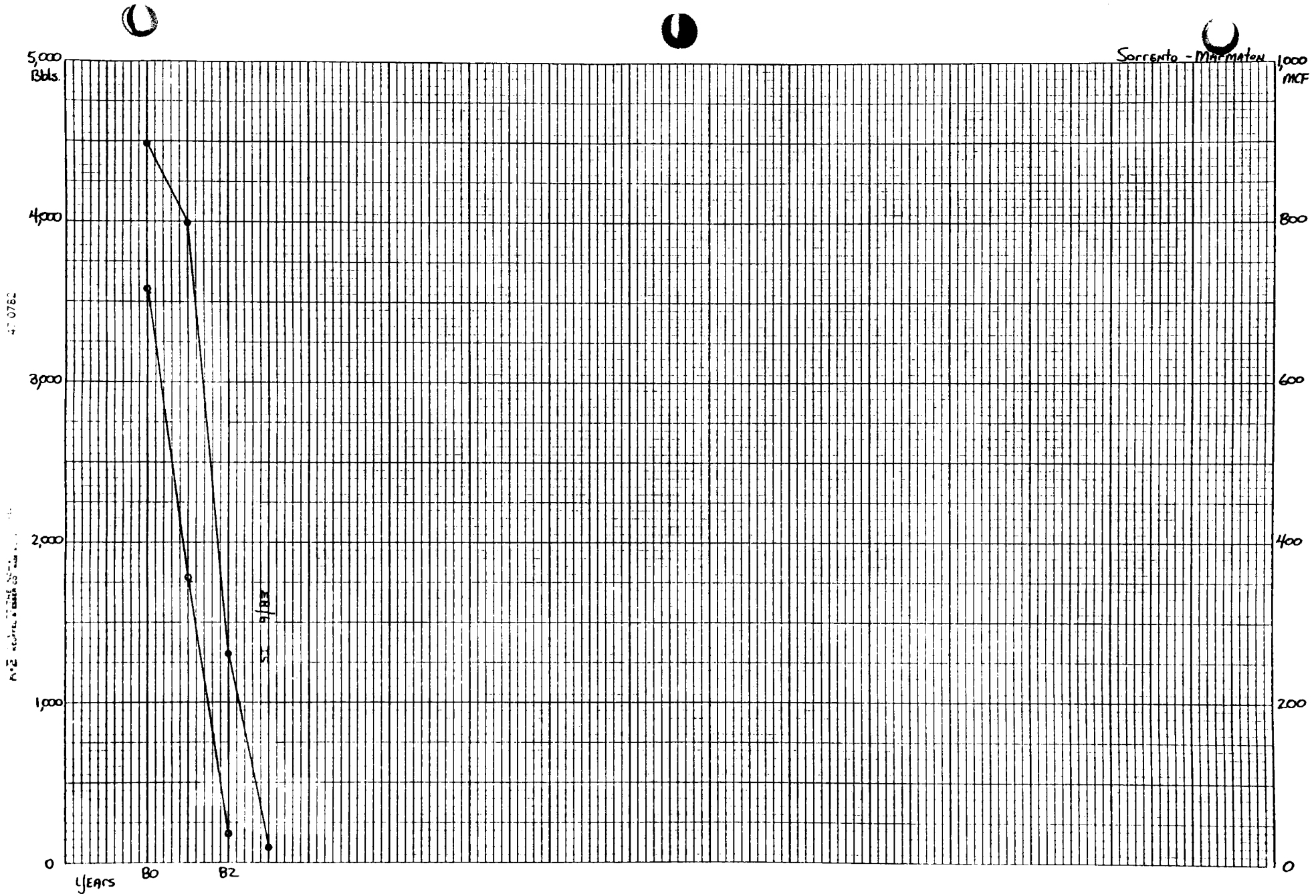

Ladder Creek - Mississippian (Spergen)
250,000 Bbls.
200,000
150,000
100,000
50,000
0
25000 MCF
20,000
15,000
10,000
5,000
0
70
72
74
76
78
80
82
Years

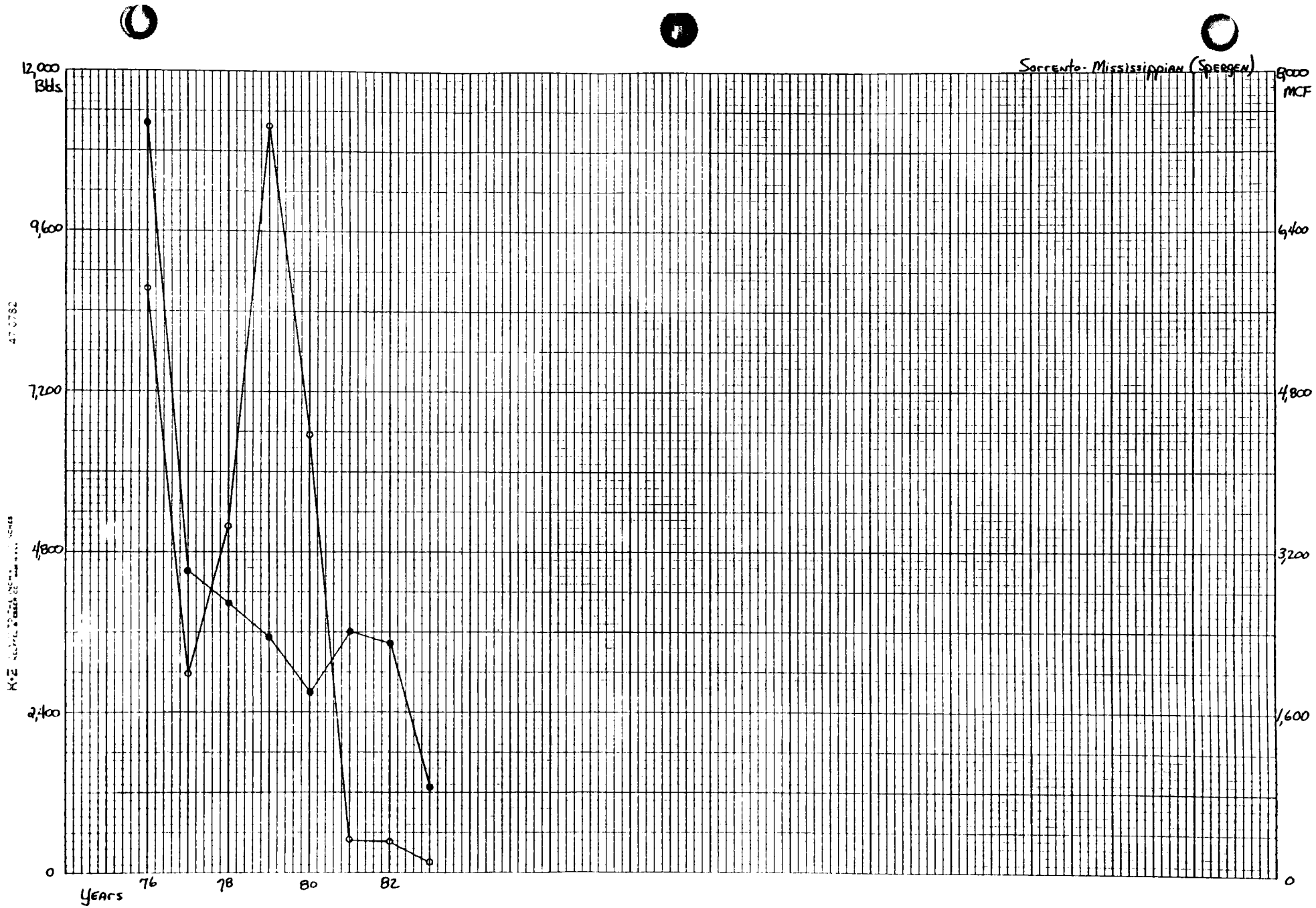

Loma - Mississippian
30,000
Bbls.
24,000
18,000
12,000
6,000
0
Years
70
72
74
76
78
80
82
47 0782
K•E

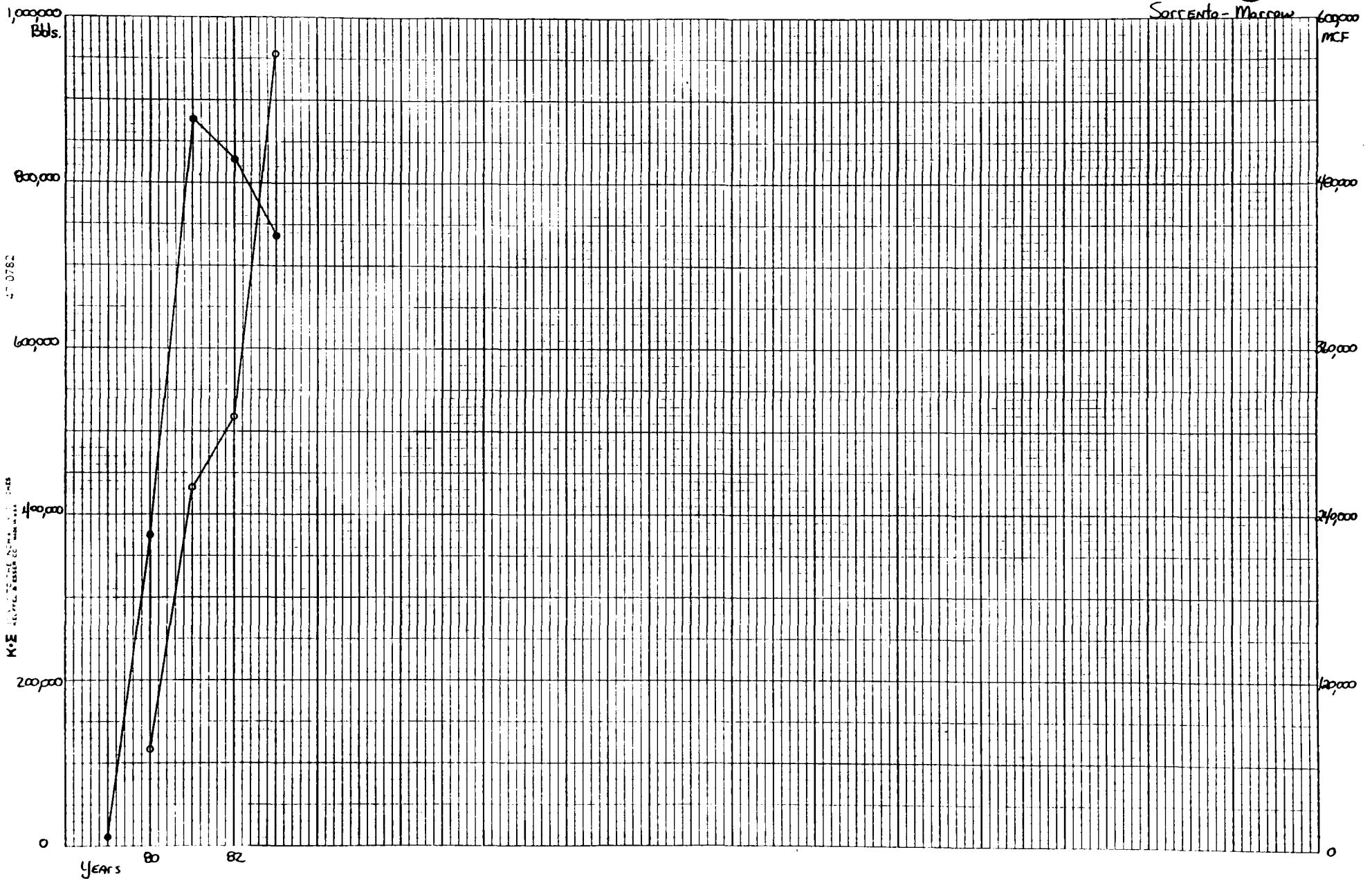

Pass Creek-Minnelusa
500
Bbls
400
300
200
100
0
Years
82
81

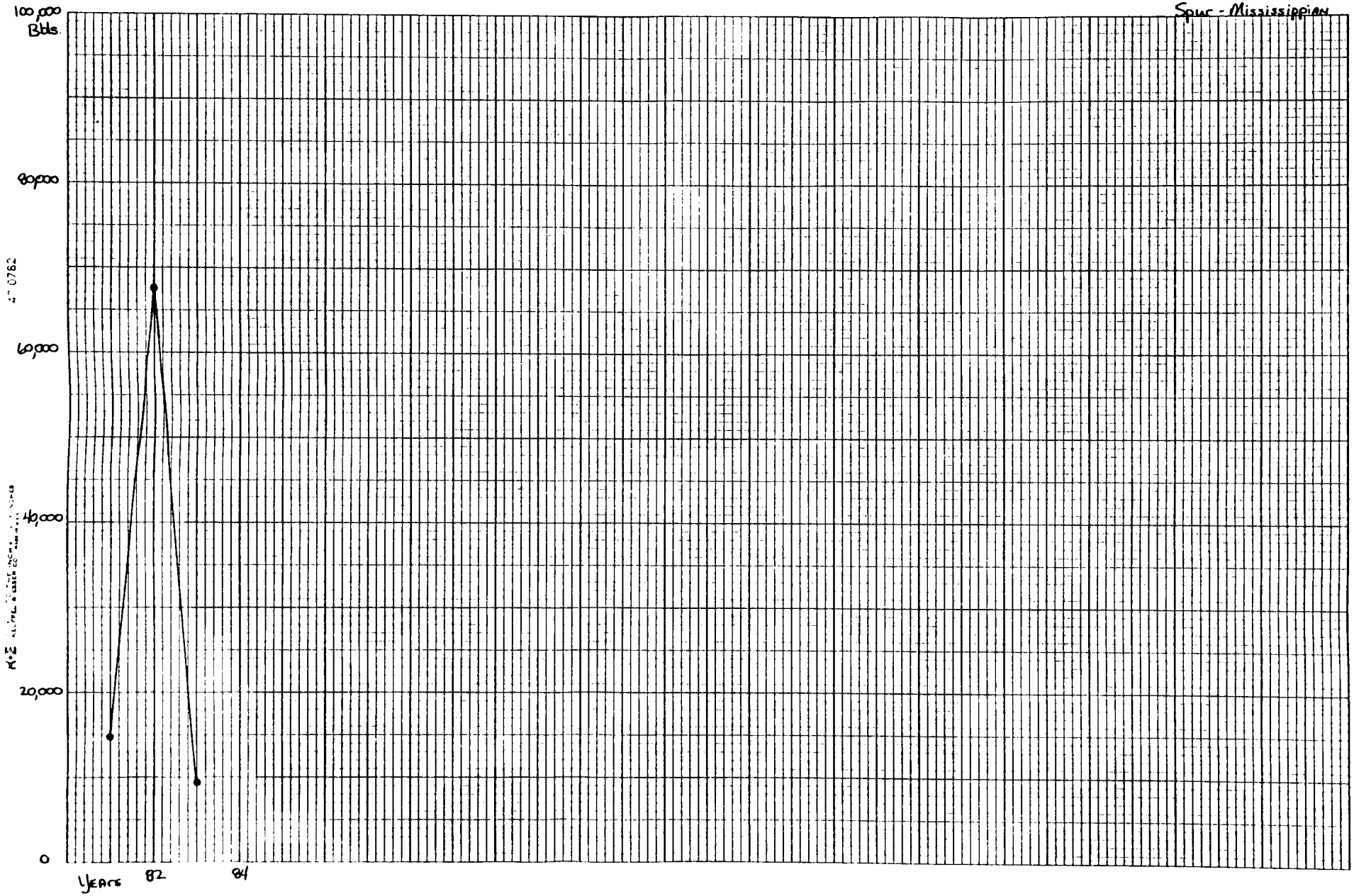

Salis-Shawnee
30,000
Bbls.
24,000
18,000
12,000
6,000
0
Years
82
84
47 0782
K·E

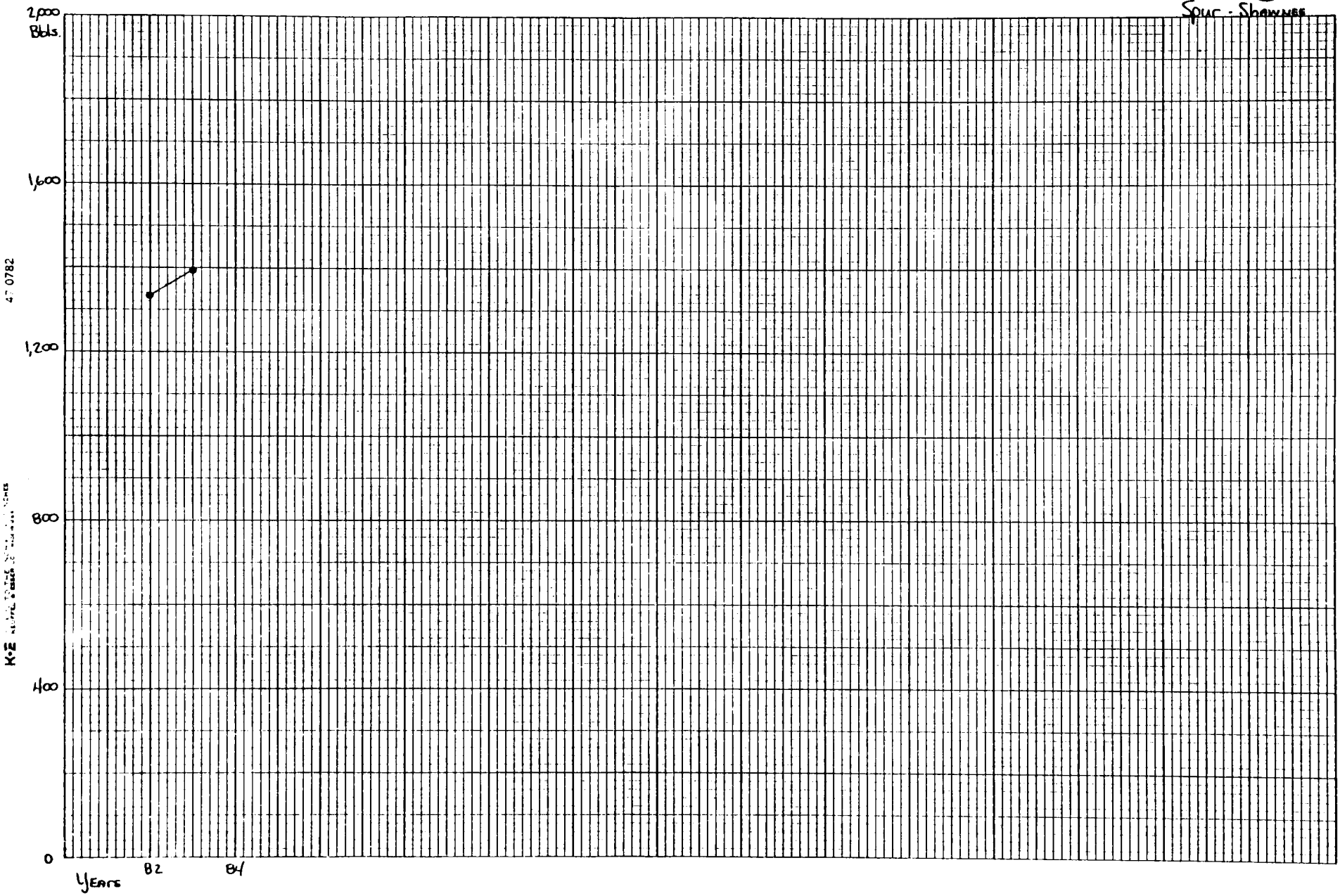

Smokey Creek-Mississippian (Speegen)
140,000
Bbls.
112,000
84,000
56,000
28,000
0
70
72
74
76
78
80
82
Years


Sorrento - Marmaton
5,000 Bbls.
4,000
3,000
2,000
1,000
0
1,000 MCF
800
600
400
200
0
Years
80
82


Sorrento - Mississippian (Speegen)
12,000
Bbls
9,600
7,200
4,800
2,400
0
9000
MCF
6,400
4,800
3,200
1,600
0
76
78
80
82
Years


Sorrento - Morrow
1,000,000 Bbls.
800,000
600,000
400,000
200,000
0
600,000 MCF
480,000
360,000
240,000
120,000
0
80
82
Years


Spur - Mississippian
100,000 Bbls.
80,000
60,000
40,000
20,000
0
YEARS
82
84


Spar - Shawnee
2,000 Bbls.
1,600
1,200
800
400
0
47 0782
K&E
82
84
Years

Other Publications

INFORMATION SERIES 18--Oil and Gas fields of Colorado: Statistical Data through 1981.
MAP SERIES 22--Oil and Gas fields map of Colorado. 1983, (1:500,000).
OPEN-FILE REPORT 84-2: Estimated Oil and Gas Reserves for Washington County, Colorado;
OPEN-FILE REPORT 84-4: Estimated Oil and Gas Reserves for Rio Blanco County, Colorado.
OPEN-FILE REPORT 84-5: Estimated Oil and Gas Reserves for Adams County, Colorado;
OPEN-FILE REPORT 83-6: Estimated Oil and Gas Reserves for Weld County, Colorado;
OPEN-FILE REPORT 84-7: Estimated Oil and Gas Reserves for Arapahoe County, Colorado,
OPEN-FILE REPORT 84-8: Estimated Oil and Gas Reserves for Baca County, Colorado.
OPEN-FILE REPORT 84-9: Estimated Oil and Gas Reserves for Cheyenne County. Colorado.
OPEN-FILE REPORT 84-10: Estimated Oil and Gas Reserves for Garfield County, Colorado;
OPEN-FILE REPORT 84-11: Estimated Oil and Gas Reserves for La Plata County, Colorado;
OPEN-FILE REPORT 84-12: Estimated Oil and Gas Reserves for Moffat County, Colorado;
OPEN-FILE REPORT 84-13: Estimated Oil and Gas Reserves for Elbert County, Colorado;
OPEN-FILE REPORT 84-14: Estimated Oil and Gas Reserves for Mesa County, Colorado;
OPEN-FILE REPORT 84-15: Estimated Oil and Gas Reserves for Routt County, Colorado;
OPEN-FILE REPORT 84-16: Estimated Oil and Gas Reserves for Yuma County, Colorado.

The Colorado Geological Survey has other publications covering topics in mineral fuels, minerals, groundwater, geothermal, and engineering and environmental geology. For a current publication list please contact:

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