ADVANCED RESOURCES INTERNATIONAL

Naturally Fractured Tight Gas
Gas Reservoir Detection Optimization

Prepared for:

U.S. Department of Energy
Morgantown Energy Technology Center

Contract No. DE-AC21-93MC30086

Quarterly Status Report

Period of Performance: April 1, 1997 - June 30, 1997

Date of Submission: September 11, 1997

Prepared by:

Advanced Resources International, Inc.

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CONTRACT NO.:

DE-AC21-93MC30086

CONTRACTOR:

Advanced Resources International, Inc.
1110 North Glebe Road, Suite 600
Arlington, VA 22201

CONTRACT NAME:

Naturally Fractured Tight Gas
Gas Reservoir Detection
Optimization

CONTRACT PERIOD:

04/1/97 - 06-30/97

CONTRACT OBJECTIVE: No Change.

TECHNICAL APPROACH CHANGES: No Change.

FIELD PERFORMANCE TEST PLAN:

The work plan for the quarter, April 1, 1997 - June 30, 1997 consisted of three tasks:

TASK 1. PREPARATION OF THE PROJECT WORK PLAN FOR THE HUNTER MESA/MAMM CREEK FIELD WITH SNYDER OIL

Following the signing of the letter of cooperation, we would proceed as set forth in the preliminary work plan of January 14 and as expanded below:

1. Base Map. Prepare a common base map for the Rulison and Hunter Mesa fields, showing:

- Structure contour on top of Rollins and J1 shale
- Shot points for all available seismic data
- Locations and names for all Williams Fork wells
- Location of key cross sections, linking Rulison to Hunter Mesa

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2. Cross-Sections. Prepare two east-west cross sections linking Rulison to Hunter Mesa and one north-south cross section through Hunter Mesa using the Geoquest package:

- Obtain digital logs from Rulison and Hunter Mesa
- Establish stratigraphic correlation between Rulison and Hunter Mesa to reconcile stratigraphic picks
- Prepare sand/shale ratio analysis
- Calculate net productive sand, using porosity cutoffs of 8% and 12%, and the estimated top of gas saturated interval
- Calculate ϕhS_g for each well on the cross-section using HDS log analysis and combine with pressure measurements to estimate gas in place

3. Lower WF Sub-Interval Analysis. Examine the gross lower Williams Fork section to establish contribution of six individual sub intervals to gas production:

- Establish common zone selection procedures, using the top of the Cameo coal for control
- Define sand development, sand/shale ratio and net ϕhS_g and gas in place for each interval
- Assemble information from 13 production surveys and gas production from selected completions/restimulations to tie productivity to interval

4. Pressure Maps. Assemble pressure data from SOCO wells and combine with Rulison data to develop pressure contour and gradient maps for Rulison/Hunter Mesa area.

5. EUR Data Base. Prepare the 52 well production completion and EUR database for Hunter Mesa, consistent with the format established for Rulison:

- Obtain EUR's for SOCO wells and compare with EUR's estimated by ARI from type curve analysis
- Estimate behind the pipe pay using HDS log analysis and potential EUR for all wells in data base

6. Productive Trends. Map the productive trends on the base map generated in Task 1 and prepare:

- Bubble maps of EUR

- Trend maps of EUR

7. HR Aeromagnetics. Conduct high resolution aeromagnetic analysis for the Hunter Mesa area and compare with standard resolution aeromagnetic analysis.

8. Remote Imagery. Prepare Landsat TM and SLAR imagery analysis for the Hunter Mesa area.

9. Seismic. Establish a seismic tie between Rulison and Hunter Mesa using line CPB1, review SOCO seismic inventory for use by the study, and analyze SOCO dipole sonic data set and its relation to seismic response.

10. Integration. Integrate aeromagnetic and remote imagery study with seismic based structural analysis to establish for Hunter Mesa:

- major structural trends/lineaments
- faults and fault geometries
- direct fracture identification using velocity inversion modeling
- relationships of seismic and aeromagnetic anomalies with production trends/anomalies

11. Interpretation and Comparison. Quantify the relationship of production/EUR with the interpreted structural setting and fracture trends at Hunter Mesa. Compare with analysis at Rulison and southern Piceance Basin.

12. Potential 3D Seismic Pilot. Review design, location and value of pilot 3D seismic program at Hunter Mesa for direct natural fracture detection and well placement.

Prelimary/For Discussion
Seismic Evaluation of Hunter Mesa 1997 Plan

1. Inventory, review and reorganization of the seismic data base and interpretations

   a. Reformat tapes to be compatible for GMA system (if necessary)

   b. Review all sources for new, available pertinent data and identify lines needed for evaluation of Hunter Mesa area

   c. Construct synthetic seismograms where needed

8 days

2. Review lines for display in new formats for subinterval evaluation. Reevaluate for critical markers

   - Pick seismic marker in GRITS
   - Correlation and interpretation

12 days

3. Modeling

   Establish if stratigraphic subintervals can be modeled and mapped using existing seismic

   - LJ1, coal Ridge to LJ1, etc.

   fractured vs. non fractured areas

4 days

4. Build a New Intergrated Seismic/Subsurface map on J1 Shale, Coal Ridge or other horizons that are shallower than the Rollins; utilizing new shallow control and establishing a structural horizon closer to top of gas.

5. Inspect and purchase Mobil lines in western portion of Hunter Mesa Project

   Confirm sturctural trend in sect 15

   Confirm Rulison

   Look for favorable LJ1 in section 29, favorable fracturing

   section 34 6S 93W, look for favorable structural trends

   Seismic correlation and interpretation, mapping

14 days

6. Interpret seismic for basement influence on Williams Fork stratigraphy

    Flatten on Rollins, Coal Ridge or Fluvial/coastal markers — 2 days

    Create isochrons and look for basement influences — 6 days

7. Create an integrated subsurface/seismic structural model

    2nd derivative mapping, mechanical model, fracture trends

8. Review and create an updated fault interpretation

    Integrate with anomalous well performance, IE. Water production in the Couey 5-10 Couey 5-12, Dunn 9-2 etc, (ties with 2. Above)

Joint projects with Vessels

9. Updated interpretations of entire area ($8,000, $4,000 net to SOCO)

Hunter Mesa
ARI/SOCO Joint Technical Analysis

The following are action items to initiate the joint technical analysis of the Hunter Mesa area by ARI for fracture detection, tying to work currently in progress at Rulison.

Formalization of the JV Technical analysis

SOCO will provide a letter of cooperation/support to ARI for the analysis of fracturing at Hunter Mesa. Attach supporting documents.

	DGS	1/15

Database exchange

Establish a common base map including Rulison and Hunter Mesa. Include shot points for all SOCO/ARI seismic data.

	DD	1/18

Provide digital logs at Rulison for use in generating a strat section in Geoquest		
	DD	1/19

Reservoir Characterization

Provide EUR's for all SOCO wells in Hunter Mesa to ARI. Prefered format is on a bubble map presentation.

	DD	1/18
Provide Pressure data on 4 SOCO wells	DF	1/18

Provide analysis of behind pipe pay for SOCO wells to be utilized by ARI in equating performance with their reservoir analysis. Utilize and document with HDS log analysis.

	DGS	2/15

Seismis/geologic

Establish a stratigraphic correlation between Hunter Mesa and Rulison using subsurface control to reconcile stratigraphic picks utilizing Geogquest.

		1/21

Review SOCO seismic inventory and prepare for utilizaiton by ARI personnel to tie to high frequencey aeromagnetics

	AR	1/19

Intiate intergration of ARI aeromagnetic study with SOCO structural analysis

	ARI	1/21

Other

Return ARI Seismic status report	DGS	1/15
Return ARI aeormagnetic interpretation map	DGS	1/15

Potential SOCO/ARI Cooperative Technical Analysis
Hunter Mesa Data Summary

Geophysical

13 lines CDP data (approx 144 miles)

Interpretations
Ohio Creek Time & Depth
Rollins Time & Depth
Frontier Time & Depth
Isochrons
- MV 5-3C
- MV 5C-CR
- CR- Rollins

9 Synthetic Seismograms

Geologic

Isopachs
- 6 Lower Williams Fork subintervals
  - Gross Isopachs (GR<60API)
  - Various net sand mapping for localized areas (8%, 12%)

Structure
- Rollins Structure
- J1 Shale Structure

Cross sections
- Williams Fork Type Cross Section
- Misc other Stratigraphic Cross Sections
- Ability to generate additional digital cross section using Geoquest

Logs/core

Open hole logs on 46 wells (FDC-CNL,DIL,GR)
Dipole Sonic on 6 wells
TDT log on 3 wells
1 Control well with full logging suite
- Cased hole Dipole Sonic, Open hole Dipole Sonic
- TDT
- Density-Neutron, Array Induction Log, GR
- FMI
- Sidewall cores (19 samples)

Production

EUR projections for 52 wells
Production survey for 13 wells
Daily, monthly, yearly production for all SOCO wells

Formation Evaluation

HDS analysis of all wells
with SgOh
Rw anlaysis

Suggested Plan for ARI analysis of SOCO data set

1. Review SOCO seismic structural interpretations
2. Complement ARI aeromagnetic/radar data with SOCO interpretations
3. Additional seismic interpretative efforts
    - Major structural trends/lineaments
    - Direct fracture identification techniques
    - Correlation between seismic and stratigraphy
    - Seismic anomalies and their relation to production anomalies
4. Analysis of SOCO dipole sonic data set and its relation to seismic response
5. Contrast structural setting/styles and fracture trends at Divide Creek/Hunter Mesa with Rulison and greater Piceance
6. Review Hunter Mesa for potential 3D seismic pilot project

TASK 2. EVALUATION OF THE USE OF 3-D SEISMIC IN THE ROCKY MOUNTAIN REGION

Background. Use of three dimensional seismic in the Rocky Mountain region has lagged when compared to other high potential exploration areas such as the Gulf Coast. The reasons have been the higher costs of working in rugged terrain and the uncertainty about the value added for the dollars spent. Recently, as shown in the attachment, considerable 3-D seismic data is being offered by vendors increasing its availability and lowering its costs. Still, the question remains - - "*how much value does 3-D seismic add*?

To help answer this question, this paper reviews three case studies:

- The experience of Amoco in their use of 3-D seismic, particulary in the Green River Basin,
- The application of multi-azimuth 3-D seismic, by Advanced Resources International, Inc. and Barrett Resources in the Piceance Basin; and
- The increased use of 3-D seismic in the Williston Basin of Montana.

Amoco's Experience with 3-D Seismic. Overall, Amoco looks very favorably on the use of 3-D seismic citing a "technological leadership position in 3-D seismic imaging", as set forth in their latest reports. Amoco states:

> "During the past three years Amoco has found about 2.5 billion barrels of oil-equivalent (15 trillion cubic feet gas - equivalent) working interest resources--more than 75% being natural gas. Application of proprietary 3-D seismic technologies, and our ability to accurately assess the quality of exploration prospects, played a major role in these accomplishments."

Amoco's U.S. exploration success rate, ranging from 40% to 83% (since 1992) compared to an industry wide exploration success rate of about 35%, bears out Amoco's increased performance from using 3-D seismic:

Amoco's U. S. Exploration Performance

Year	Successful Wells	Dry Wells	% Success
1992	27	52	34%
1993	29	6	83%
1994	43	12	78%
1995	53	47	53%
1996	51	78	40%

In the Rockies, and particulary in the Greater Green River Basin of Wyoming, Amoco hopes to shoot to 1,500 square miles of 3-D seismic in the next 5 years.

To gain a stronger perspective on the reliability of 3-D seismic processing, Amoco recently sent the same 9-square-mile subset of a 3-D seismic survey to eight different processors. Amoco took a hands-off approach to the processing, but gave the processing companies 10 parameters which included good stratigraphic interpret ability, good imaging of deep basement faults, and ties to well control. Amoco also specified an area of interest, a sinuous channel feature in the Almond Formation.

Amoco found the results of the proximity test both "intriguing and disturbing." According to Amoco, "What was such a shock to us was the fact that the products were quite, quite different. And I can honestly say that with three of the products we would not be shooting any more 3-D if those were the only process we had. "It's really scary."

Amoco personnel were so concerned with the reliability of the processing techniques that they now routinely send the same 3-D data set to different processors. Processing accounts for only about 5% of the total cost of the 3-D product. Amoco stated "we believe it is well worth the money to obtain more that one version of the data." Amoco found that no one contractor excelled in every quality criteria, instead, each processor had unique strengths and weakness.

Piceance Basin Multi-Azimuth 3-D Seismic Project. Currently, Advanced Resources International, Inc. is completing a project with Barrett Resources in the Rulison Field (Mesarvede\Williams Fork), Piceance Basin to test the reliability and value of alternative technologies for finding naturally fractured "sweet spots" in tight sand reservoirs (Appendix B).

As part of this project, Advanced Resources (with funding from DOE/FETC) contracted for a P-wave, multi-azimuth 3-D seismic survey (conducted by Western Geophysical). The seismic acquisition covered 4.5 square miles and was located over both of the most fractured and the least fractured portions of the Rulison Field. The technical requirements for the P-wave reflection data were -- "full-fold, full-offset, full-azimuth". Four independent interpretations are being performed on the seismic data:

- Advanced Resources International, Inc. has interpreted 400 line miles of 2-D seismic for structural control and is interpreting the fault location and geometry from the 3-D data set at Rulison.

- Lynn, Inc. is using three seismic attributes --azimuthally dependent interval velocity, velocity anisotrophy and AVO gradients --to identify fracture prone areas in the seismic area.

- Neidell & Associates is using their velocity inversion modeling on a cross section of wells across the seismic area. Western Geophysical is using this high quality seismic data and control wells within the seismic grid to demonstrate their "Fractogram" model.

The use of the high resolution 3-D seismic, particulary for detailed mapping of the subtle faults and fractures in the Rulison Field, has provided a potentially valuable methodology for more reliability locating naturally fractured settings. For example, wells in the main fault and fracture affected zone averaged about 1 Bcf\well higher than wells outside the fault zone, as shown below:

Correlation of Mapped Faults and Well Performance at Rulison

	Inside NW2 Fault Zone	Outside NW2 Fault Zone
No. Wells	17	10
Average EUR\Well	2.32 Bcf	1.37 Bcf

Additional information on this project is provided in the Attachment to this paper and in various reports.

__Use of 3-D Seismic in the Williston Basin, Montana__. An increase in 3-D seismic activity in northeast Montana's Williston Basin has resulted in a dramatic turnaround in an area that had been almost abandoned by oil industry in the late 80's. In the last few years, new wells have been drilled in this sector as more sophisticated data from 3-D surveys brings back both major oil companies and independents. Texaco and Union Pacific Resources are among the major oil companies returning to the area, but small independents also are shooting seismic there.

The Williston Basin is rich in multiple stack objectives, lowering the cost of seismic per drill target. 3-D has enhanced subsurface exploration so that it can define where the bottom hole location of the drill bit should be and perhaps even the porosity that lies in its path. Last year several companies drilled 11 wells in the area based on results from 3-D seismic data. Of those, six wells were successful and five were dry holes. The industry credits 3-D seismic as being the main factor in the higher drilling success rate. The technology's main drawback is that it remains more costly than 2-D seismic.

One of the active companies, Texaco, is focusing on northeastern Montana. About a third of that area has already been shot with 3-D seismic and Texaco is currently shooting a 25-square mile program. A 62-square-mile-survey was shot three years ago. So far, Texaco has drilled four wells in the area. Three were successful and each produces about 350 barrels of oil a day. Each well has about 400,00 barrel reserve over the life of the well. "The success rates are obviously higher with 3-

D," according to Texaco. "You can better define things. However, 3-D opens a lot more questions. Because of the intensive data it provides. A lot of our concepts have changed."

Summit Resources is focusing on extensions of existing fields in Montana's Williston Basin, looking at the stratigraphic traps along the flanks of old developed structures. Summit -- which opened a Denver office last year--has mostly been shooting 3-D in Richland and Sheridan Counties in northeastern Montana. Last year the company drilled three wells in that area. Of those, two were a success and one was an economic failure. High-gravity oil has been found there, and Summit's wells are producing from 250 to 350 barrels of oil a day. Union Pacific Resources also has shot about 40 square miles of 3-D seismic in northeastern Montana in the last few months.

TASK 3: PREPARATION OF THE FIRST VERSION OF THE EUR CONTROL SET

See attached Appendix A.

APPENDIX A

EUR CONTROL SET

LEASE	FIELD	API	T	R	Sec.	Comp.	Recomp.	# Zones	Zone #1	Zon
ARCO-EXXON # 1-36	MAM CREEK	05-045-06053	6S	93W	36	Dec-74		1	5406-6680	
BENNETT #32- 7	MAM CREEK	05-045-07071	6S	92W	32	Aug-96		1	4742-5288	
BENNETT #32-10	MAM CREEK	05-045-06937	6S	92W	32	Dec-94		3	4424-5060	522
BENZEL # 1-12	MAM CREEK	05-045-06846	7S	93W	01	Nov-94		4	5552-5636	575
BENZEL #26-16	MAM CREEK	05-045-06889	6S	93W	26	Oct-94		4	5734-6048	622
BENZEL #36-16	MAM CREEK	05-045-06936	6S	93W	36	Dec-94		3	5287-5623	572
BJM # 6-16	MAM CREEK	05-045-07046	7S	92W	06	Mar-96		1	4934-5272	
COOK #12-16	MAM CREEK	05-045-06952	7S	93W	12	Jan-95		2	5151-5782	670
COUEY # 5-10	MAM CREEK	05-045-07089	7S	92W	05	Oct-96		1	4252-4843	
COUEY # 5-12	MAM CREEK	05-045-07090	7S	92W	05	Oct-96		2	4451-5025	521
COUEY # 5-14	MAM CREEK	05-045-07069	7S	92W	05	Aug-96		2	4248-4860	505
COUEY #13-16	MAM CREEK	05-045-06954	7S	93W	13	Feb-95		3	5269-5828	598
COUEY #18-10	MAM CREEK	05-045-07009	7S	92W	18	Jun-96		3	4762-4992	516
COUEY #32-14	MAM CREEK	05-045-07055	6S	92W	32	Apr-96		1	4825-5094	
COUEY #32-15	MAM CREEK	05-045-07042	6S	92W	32	Feb-96		1	4462-4833	
DUNN # 4-11	MAM CREEK	05-045-07072	7S	92W	04	Nov-96		1	4512-4822	
DUNN # 4-12	MAM CREEK	05-045-07111	7S	92W	04	Nov-96		1	4560-4915	
DUNN # 5- 9	MAM CREEK	05-045-07060	7S	92W	05	May-96		1	4226-4692	
DUNN # 9- 2	MAM CREEK	05-045-06907	7S	92W	09	Dec-94		4	4282-4442	457
DUNN #32-16	MAM CREEK	05-045-07101	6S	92W	32	Oct-96		1	4679-5062	
GRAHAM #13- 1	MAM CREEK	05-045-07108	7S	93W	13	Nov-96		2	5174-5623	588
GRASS MESA RANCH #27- 4	MAM CREEK	05-045-06902	6S	93W	27	Nov-94		3	6992-7228	738
GRASS MESA RANCH #33- 1	MAM CREEK	05-045-06733	6S	93W	33	Jul-91		2	8287-8763	889
HILL # 9-12	MAM CREEK	05-045-07052	7S	92W	09	May-96		2	4334-4532	464
HMU FEDERAL # 5-16	MAM CREEK	05-045-07114	7S	92W	05	Dec-96		1	4460-4873	
HMU FEDERAL #30-16	MAM CREEK	05-045-06878	7S	92W	30	Oct-94		3	5635-5750	598
KELL #35-12	MAM CREEK	05-045-06934	6S	93W	35	Dec-94		3	6042-6340	659
KRK # 7- 1	MAM CREEK	05-045-07076	7S	92W	07	Sep-96		2	4807-5415	559
KRK # 7- 3	MAM CREEK	05-045-06999	7S	92W	07	Sep-95		2	4968-5515	595
KRK # 7- 7	MAM CREEK	05-045-07000	7S	92W	07	Mar-96		1	4998-5558	
KRK # 7- 8	MAM CREEK	05-045-06843	7S	92W	07	Oct-94		2	4707-5182	586
KRK # 7- 9	MAM CREEK	05-045-07117	7S	92W	07	Jan-97		1	5436-6099	
KRK # 7-10	MAM CREEK	05-045-07039	7S	92W	07	Feb-96		2	4796-5174	591
KRK # 7-11	MAM CREEK	05-045-06938	7S	92W	07	Jan-95		2	5265-5890	619
KRK # 7-15	MAM CREEK	05-045-07040	7S	92W	07	Jan-96		3	4810-5155	530
KRK # 7-16	MAM CREEK	05-045-06948	7S	92W	07	Dec-94		2	5068-5442	571
MAM CREEK RANCH #29- 4	MAM CREEK	05-045-06850	7S	92W	29	Oct-94		3	4998-5488	561
PARKER RANCH #10- 9	MAM CREEK	05-045-06943	7S	93W	10	Aug-95		2	6539-7095	730
PARKER RANCH #11-14	MAM CREEK	05-045-06929	7S	93W	11	Jun-96		2	6371-6569	668
PARKER RANCH #14-10	MAM CREEK	05-045-06856	7S	93W	14	Jul-94		4	5814-6220	631
PARKER RANCH #15- 4	MAM CREEK	05-045-06940	7S	93W	15	Jul-96		1	6786-7360	
PARKER RANCH #15- 8	MAM CREEK	05-045-06909	7S	93W	15	Dec-94		3	6727-7115	734
PARKER RANCH #22- 7	MAM CREEK	05-045-06899	7S	93W	22	Dec-94		4	6718-6868	714
PITMAN #13- 4	MAM CREEK	05-045-06894	7S	93W	13	Oct-94		4	5642-5986	612
PITMAN #18- 2	MAM CREEK	05-045-06950	7S	92W	18	Jan-95		3	4794-5193	539
R. H. RANCH #1	MAM CREEK	05-045-06377	6S	93W	34	Oct-85		5	6856-7491	762
SHAEFFER #12- 6	MAM CREEK	05-045-06847	7S	93W	12	Sep-94		3	5378-5842	609
SHAEFFER #12- 8	MAM CREEK	05-045-07004	7S	93W	12	Mar-96		2	5308-5747	592
SHAEFFER #18- 5	MAM CREEK	05-045-06830	7S	92W	18	Jan-94		3	4998-5777	596
SHAEFFER, J. #1	MAM CREEK	05-045-05064	7S	93W	12	Aug-59		1	8444-8588	
SHIDELER #25-10	MAM CREEK	05-045-06851	7S	93W	25	Oct-94		3	5672-6015	617
YOUBERG RU #11- 7	RULISON	05-045-06818	S	9W	7	Nov-94		3	7016-7117	728

#2	Zone #3	Zone #4	1st month	2nd month	3rd month	Best 6 (mmcf)	Cum. (mmcf)
			8756	8842	5078	41.3	123.6
			21687	17065	12367	72.6	72.6
5-5410	5693-5954		19363	36239	32490	153.2	428.5
7-6132	6596-6911	7221-7314	7905	4529	6084	39.0	99.7
2-6573	6762-7101	7262-7340	41236	19264	10990	111.8	279.2
9-5989	6326-6647		23700	10896	12049	75.4	192.8
			26153	17029	15324	90.6	122.1
7-7104			16514	14849	13228	79.9	233.8
			17244	6522	2888	26.7	26.7
1-5818			7976	4701	2080	14.8	14.8
3-5680			24406	17220	15689	82.5	82.5
3-6448	6770-6994		30232	27753	22900	135.0	323.6
5-5459	5642-6021		30406	19076	14118	98.6	109.4
			41824	36056	23990	150.1	181.8
			26084	36010	25232	145.9	221.3
			30080	28146		28.1	58.2
			43067			46.2	46.2
			35755	44381	34431	187.9	219.2
5-4813	5135-5499	5687-6180	158862	129626	17185	95.9	290.4
			9648	10076		22.9	22.9
0-6447			4121	19292		23.4	23.4
5-7778	7960-8538		12360	6958	5328	39.0	100.0
2-8949			5885	3907	5598	37.8	172.9
0-5022			22384	10032	8538	58.5	64.2
			6450			6.5	6.5
3-6190	6577-7065		20800	10854	8959	71.8	183.0
4-6817	7076-7494		32462	17868	11700	93.5	186.0
5-6108			14919	35592	72765	141.7	141.7
3-6674			20715	15997	13558	83.1	166.3
			58893	45212	35537	229.0	304.5
5-6484			33885	55302	49109	424.7	1060.8
						0.0	0.0
3-6316			28421	17923	6275	99.4	134.8
2-6686			15236	48404	34737	191.0	476.0
2-5683	5954-6297		15151	32850	30404	139.7	212.6
1-6330			19276	52657	50559	266.4	728.4
5-6072	6218-6420		25754	19599	13732	113.1	313.5
3-7871			49921	28280	28361	178.3	327.8
1-6865			13890	8995	7959	49.0	53.3
6-6616	6834-7166	7246-7508	7078	15663	11859	61.1	168.0
			32367	23981	17716	111.7	111.7
4-7837	8181-8436		27031	39345	31679	160.5	430.8
0-7390	7606-8005	8166-8417	16288	15193	10287	63.9	154.0
9-6527	6703-7017	7181-7513	12356	36490	25438	130.5	349.5
7-6048	6416-6654		24410	36177	25368	151.5	401.9
8-7803	7910-8003	8089-8521	6971	7091	8920	94.9	576.4
8-6144	6383-6974		22773	16039	26904	111.0	327.9
6-6365			18991	12092	9408	62.6	84.3
5-6421	6582-6983		9881	24845	20310	139.3	413.0
						65.3	818.4
1-6328	7072-7618		17088	9836	6622	53.3	120.7
3-7738	8059-8594		35160	31156	37820	489.0	1301.5

Piceance Basin Mam Creek Pay Zones

File #	Well Name	Total Thickness ft	PAY 1 Top Cameo Coal	PAY 1 Bottom Cameo Coal	PAY 2 Top Cameo SS	PAY 2 Bottom Cameo SS	PAY 3 Top MV	PAY 3 Bottom MV	PAY 4 Top MV	PAY 4 Bottom MV	PAY 5 Top MV	PAY 5 Bottom MV	PAY 6 Top MV	PAY 6 Bottom MV
1	ARCO-EXXON # 1-36	200					5406	6680						
2	BENNET #32-7	100					4742	5288						
3	BENNET #32-10	100					4424	5060						
4	BENZEL #1-12	400	7221	7314			6596	6911	5757	6132	5552	5636		
5	BENZEL #26-16	400					7262	7340	6726	7101	6222	6573	5734	6048
6	BENZEL #36-16	300					6326	6647	5729	5989	5287	5623		
7	BJM # 6-16	100					4934	5272						
8	COOK 12-16	200					6707	7104	5151	5782				
9	COUEY 5-10	100					4252	4843						
10	COUEY 5-12	200					5211	5822	4451	5025				
11	COUEY 5-14	200					5053	5680	4248	4860				
12	COUEY 13-16	300					6770	6994	5998	6448	5269	5829		
13	COUEY 18-10	300					5642	6021	5166	5459	4762	4992		
14	COUEY 32-14	100					4825	5094						
15	COUEY 32-15	100					4462	4833						
16	DIVIDE CREEK #21													
17	DIVIDE CREEK UNIT													
18	DUNN #4-11	100					4512	4823						
19	DUNN #4-12	100					4560	4915						
20	DUNN #5-9	100					4226	4692						
21	DUNN #9-2	200					4575	4813	4282	4442				
22	DUNN #32-16	100					4679	5062						
23	GRAHAM #13-1	200					5880	6447	5174	5623				
24	GRASS MESA RANCH #27-4	300					7960	8538	7386	7778	6992	7228		
25	GRASS MESA RANCH #33-1	200	8892	8949	8287	8763								
26	HILL #9-12	100					4334	4532						
27	HMU FEDERAL #5-16	100					4460	4873						
28	HMU FEDERAL #30-16	300					6577	7065	5988	6196	5635	5720		
29	KELL #35-12	300					7076	7494	6594	6817	6042	6340		
30	KRK #7-1	200					5595	6108	4807	5415				
31	KRK #7-3	200					5953	6674	4968	5515				
32	KRK #7-7	100					4998	5558						
33	KRK #7-8	200					5865	6484	4707	5182				
34	KRK #7-9	100					5436	6099						
35	KRK #7-10	200					5918	6316	4796	5174				
36	KRK #7-11	200					6192	6686	5265	5890				
37	KRK #7-15	300					5954	6297	5302	5683	4810	5155		
38	KRK #7-16	200					5711	6330	5068	5442				
39	MAM CREEK RANCH #29-4	300					6218	6420	5615	6072	4998	5488		
40	PARKER RANCH #10-9	200					7303	7871	6539	7095				
41	PARKER RANCH #11-14	200					6681	6865	6371	6569				
42	PARKER RANCH #14-10	400					7246	7508	6834	7166	6316	6616	5814	6220
43	PARKER RANCH #15-4	100					6786	7360						
44	PARKER RANCH #15-8	300					8181	8436	7344	7837	6727	7115		
45	PARKER RANCH #22-7	400					8166	8417	7606	8005	7140	7390	6718	6868
46	PITMAN #13-4	400	7181	7513	6703	7017	6129	6527	5642	5986				
47	PITMAN #18-2	300					6416	6654	5397	6048	4794	5193		
48	R. H. RANCH #1	500			8881	9004	8099	8521	7910	8003	7628	7803	6856	7491
49	SHAEFFER #12-6	300					6383	6974	6098	6144	5378	5642		
50	SHAEFFER #12-8	200					5926	6365	5308	5747				
51	SHAEFFER #18-5	300					6582	6983	5965	6421	4998	5777		
52	SHAEFFER, J. #1	100					8444	8588	0	0				
53	SHIDELER #25-10	300					7072	7618	6171	6328	5672	6015		
54	YOUBERG RU #11-7	300			8059	8594	7283	7738	7016	7117				

RECOMPLETIONS ACID. PAYS NO FRAC

Piceance Basin Mam Creek Area Pay Zones Comments

File #	Well Name	Comments
1	ARCO-EXXON # 1-36	
2	BENNET #32-7	Top & Bottom: 5433',4382'
3	BENNET #32-10	2 Lower zones plugged due to high water producti
4	BENZEL #1-12	
5	BENZEL #26-16	
6	BENZEL #36-16	
7	BJM # 6-16	
8	COOK 12-16	
9	COUEY 5-10	Top & Bottom: 4970',4004'
10	COUEY 5-12	Top & Bottom: 5977',4414'
11	COUEY 5-14	Top & Bottom: 6028',4150'
12	COUEY 13-16	
13	COUEY 18-10	
14	COUEY 32-14	Top & Bottom: 5790',4410'
15	COUEY 32-15	
16	DIVIDE CREEK #21	
17	DIVIDE CREEK UNIT	
18	DUNN #4-11	Top & Bottom: 5700',4150'
19	DUNN #4-12	Top & Bottom: 5700',4100'
20	DUNN #5-9	Top & Bottom: 4980',4100'
21	DUNN #9-2	
22	DUNN #32-16	Top & Bottom: 5205',4221'
23	GRAHAM #13-1	Top & Bottom: 6750',5000'
24	GRASS MESA RANCH #27-4	WL tag @ 8695' (12/94)
25	GRASS MESA RANCH #33-1	Cameo D Coal & Coal Ridge
26	HILL #9-12	CIBP @ 4610'. Top & Bottom: 5666',3820'
27	HMU FEDERAL #5-16	
28	HMU FEDERAL #30-16	
29	KELL #35-12	
30	KRK #7-1	Recompleted 11/6/96. Top & Bottom: 6235',453
31	KRK #7-3	
32	KRK #7-7	
33	KRK #7-8	
34	KRK #7-9	
35	KRK #7-10	
36	KRK #7-11	
37	KRK #7-15	
38	KRK #7-16	
39	MAM CREEK RANCH #29-4	
40	PARKER RANCH #10-9	Schematic reveals possible dual completion.
41	PARKER RANCH #11-14	Top & Bottom: 7607',6000'
42	PARKER RANCH #14-10	
43	PARKER RANCH #15-4	Top & Bottom: 7607',6000'
44	PARKER RANCH #15-8	
45	PARKER RANCH #22-7	
46	PITMAN #13-4	Pay 2 is Cameo SS/MV
47	PITMAN #18-2	
48	R. H. RANCH #1	Pay 2-4 indicated as Frac, only acid listed. All M
49	SHAEFFER #12-6	
50	SHAEFFER #12-8	
51	SHAEFFER #18-5	
52	SHAEFFER, J. #1	
53	SHIDELER #25-10	
54	YOUBERG RU #11-7	

Tops and Bottoms taken from Snyder Oil Corporation.

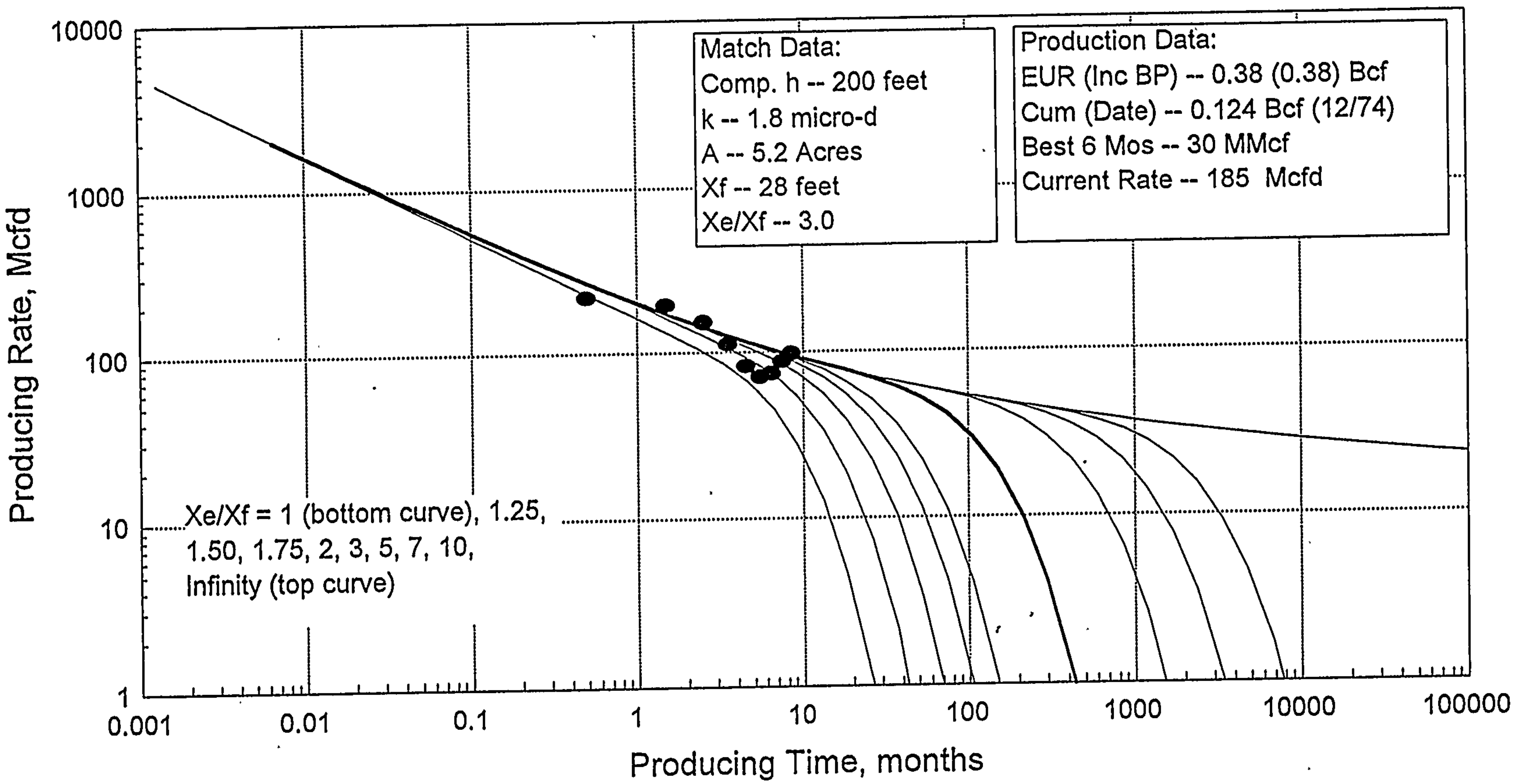
PRESSURES FOR THE MAM CREEK AREA							
WELL #	WELL NAME	TSHIP	RANGE	SECTION	Pr	Pwf	Plot File #
1	ARCO-EXXON # 1-36	6S	93W	36	4000	500	1
2	BENNET #32-7	6S	92W	32	4000	500	1
3	BENNET #32-10	6S	92W	32	4000	500	1
4	BENZEL #1-12	7S	93W	1	4000	500	1
5	BENZEL #26-16	6S	93W	26	4000	500	1
6	BENZEL #36-16	6S	93W	36	4000	500	1
7	BJM #6-16	7S	92W	6	4000	500	1
8	COOK 12-16	7S	93W	12	4000	500	1
9	COUEY 5-10	7S	92W	5	4000	500	1
10	COUEY 5-12	7S	92W	5	4000	500	2
11	COUEY 5-14	7S	92W	5	4000	500	2
12	COUEY 13-16	7S	93W	13	4000	350	2
13	COUEY 18-10	7S	92W	18	4000	500	2
14	COUEY 32-14	6S	92W	32	4000	500	2
15	COUEY 32-15	6S	92W	32	4000	500	2
16	DIVIDE CREEK #21	8S	91W	12			
17	DIVIDE CREEK UNIT	8S	91W	26			
18	DUNN #4-11	7S	92W	4	4000	500	2
19	DUNN #4-12	7S	92W	4	4000	500	2
20	DUNN #5-9	7S	92W	5	4000	500	2
21	DUNN #9-2	7S	92W	9	4000	500	2
22	DUNN #32-16	6S	92W	32	4000	500	3
23	GRAHAM #13-1	7S	93W	13	4000	500	3
24	GRASS MESA RANCH #27-4	6S	93W	27	4000	500	3
25	GRASS MESA RANCH #33-1	6S	93W	33	4000	500	3
26	HILL #9-12	7S	92W	9	4000	500	3
27	HMU FEDERAL #5-16	7S	92W	5	4000	500	3
28	HMU FEDERAL #30-16	7S	92W	30	4000	500	3
29	KELL #35-12	6S	93W	35	4000	500	3
30	KRK #7-1	7S	92W	7	4000	500	3
31	KRK #7-3	7S	92W	7	4000	500	3
32	KRK #7-7	7S	92W	7	4000	500	4
33	KRK #7-8	7S	92W	7	4000	500	4
34	KRK #7-9	7S	92W	7	4000	500	4
35	KRK #7-10	7S	92W	7	4000	500	4
36	KRK #7-11	7S	92W	7	4000	500	4
37	KRK #7-15	7S	92W	7	4000	500	4
38	KRK #7-16	7S	92W	7	4000	500	4
39	MAM CREEK RANCH #29-4	7S	92W	29	4000	500	4
40	PARKER RANCH #10-9	7S	93W	10	4000	500	4
41	PARKER RANCH #11-14	7S	93W	11	4000	500	4
42	PARKER RANCH #14-10	7S	93W	14	4000	500	5
43	PARKER RANCH #15-4	7S	93W	15	4000	500	5
44	PARKER RANCH #15-8	7S	93W	15	4000	500	5
45	PARKER RANCH #22-7	7S	93W	22	4000	500	5
46	PITMAN #13-4	7S	93W	13	4000	500	5
47	PITMAN #18-2	7S	92W	18	4000	500	5
48	R. H. RANCH #1	6S	93W	34	4000	500	5
49	SHAEFFER #12-6	7S	93W	12	4000	500	5
50	SHAEFFER #12-8	7S	93W	12	4000	500	5
51	SHAEFFER #18-5	7S	92W	18	4000	500	5
52	SHAEFFER J. #1	7S	93W	12	4000	500	6
53	SHIDELER #25-10	7S	93W	25	4000	500	6
54	YOUBERG RU #11-7	7S	93W	7	4000	500	1

Final Fractured Reservoir Type Curve Matching Results For the Piceance Basin Mam Creek Area													
File #	Well Name	Thickness ft	Qma	Tma	Xe/Xf	Match * Quality	Pre-1970 MMcf	Cum MMcf	40 EUR MMcf	Perm micro D	Xf ft	Xe Acres	30 Yr EUR Bcf
1	ARCO-EXXON # 1-36	200	125.216	13.021	3.00	0	0	123.598	275.174	1.8	28	5	0.38
2	BENNET #32-7	100	582.187	5.797	3.00	0	0	72.597	554.022	16.4	60	24	0.98
3	BENNET #32-10	100	822.515	13.401	2.00	3	0	428.468	781.592	23.1	104	32	1.47
4	BENZEL #1-12	400	191.716	13.000	2.50	0	0	99.743	292.242	1.3	25	3	0.47
5	BENZEL #26-16	400	442.724	18.119	2.00	1	0	279.167	580.083	3.1	44	6	1.03
6	BENZEL #36-16	300	314.821	16.109	2.20	2	0	192.830	455.953	2.9	41	6	0.76
7	BJM #6-16	100	404.556	10.000	2.50	1	0	122.050	477.847	11.4	63	18	0.81
8	COOK 12-16	200	404.556	15.209	2.00	2	0	233.846	455.754	5.7	55	9	0.81
9	COUEY 5-10	100	333.446	4.184	3.00	0	0	26.654	227.931	9.4	37	9	0.43
10	COUEY 5-12	200	213.035	10.000	2.50	0	0	14.757	235.537	3.0	32	5	0.43
11	COUEY 5-14	200	690.234	4.694	3.00	0	0	82.490	529.197	9.7	40	10	0.97
12	COUEY 13-16	300	507.130	22.475	2.00	3	0	323.631	841.100	4.7	60	11	1.41
13	COUEY 18-10	300	388.125	17.250	2.00	1	0	109.382	498.711	3.6	47	6	0.86
14	COUEY 32-14	100	465.239	20.114	2.00	1	0	181.845	718.254	13.1	95	27	1.17
15	COUEY 32-15	100	600.204	17.490	2.00	2	0	221.302	777.561	16.9	101	30	1.35
16	DIVIDE CREEK #21	0	100.000	10.000	3.00	0	0	1,506.422	1,536.186				
17	DIVIDE CREEK UNIT	0	100.000	10.000	3.00	0	0	*************	*************				
18	DUNN #4-11	100	813.706	6.575	2.50	0	0	58.226	604.763	22.9	72	24	1.14
19	DUNN #4-12	100	690.234	5.398	3.00	0	0	46.175	631.681	19.4	60	24	1.10
20	DUNN #5-9	100	670.680	18.000	2.00	0	0	219.235	910.448	18.8	108	35	1.54
21	DUNN #9-2	200	465.239	17.490	2.00	3	0	290.372	602.866	6.5	63	12	1.05
22	DUNN #32-16	100	266.002	11.342	2.50	0	0	22.856	339.413	7.5	54	14	0.59
23	GRAHAM #13-1	200	460.156	11.022	2.00	0	0	23.413	344.994	6.5	50	7	0.69
24	GRASS MESA RANCH #27-4	300	174.901	13.225	2.00	2	0	99.992	171.151	1.6	27	2	0.31
25	GRASS MESA RANCH #33-1	200	150.000	22.500	2.00	2	0	172.907	248.190	2.1	41	5	0.41
26	HILL #9-12	100	231.306	10.000	2.50	0	0	64.185	276.913	6.5	47	10	0.46
27	HMU FEDERAL #5-16	100	115.000	10.000	2.00	0	0	6.450	82.044	3.2	33	3	0.16
28	HMU FEDERAL #30-16	300	220.174	29.891	1.80	2	0	183.017	404.129	2.1	46	5	0.65
29	KELL #35-12	300	225.000	19.565	2.50	1	0	185.991	551.679	2.1	38	7	0.74
30	KRK #7-1	200	100.000	10.000	3.00	0	0	141.677	295.958	0.0	0	0	0.00
31	KRK #7-3	200	351.788	20.114	2.00	2	0	166.293	517.724	4.9	59	10	0.89
32	KRK #7-7	100	922.918	17.980	2.00	2	0	304.455	1,211.084	25.9	127	47	2.12
33	KRK #7-8	200	1,506.410	24.484	2.00	1	0	1,060.779	2,711.452	21.2	134	53	4.43
34	KRK #7-9	100	100.000	10.000	3.00	0	0	0.000	162.879	0.0	0	0	0.00
35	KRK #7-10	200	382.797	20.114	2.00	0	0	134.812	558.105	5.4	61	11	0.96
36	KRK #7-11	200	615.279	26.600	2.00	2	0	475.957	1,257.597	8.6	89	23	1.92
37	KRK #7-15	300	499.301	22.813	2.00	1	0	212.589	845.708	4.7	61	11	1.39
38	KRK #7-16	200	935.762	40.456	1.50	2	0	728.380	1,525.699	13.1	136	30	2.73
39	MAM CREEK RANCH #29-4	300	428.490	37.260	1.50	2	0	313.469	618.174	4.0	72	9	1.17
40	PARKER RANCH #10-9	200	471.714	45.256	1.50	2	0	327.829	890.182	6.6	102	17	1.51
41	PARKER RANCH #11-14	200	172.500	22.813	1.50	1	0	53.325	161.654	2.4	44	3	0.31
42	PARKER RANCH #14-10	400	221.912	44.634	1.50	0	0	167.973	371.068	1.6	49	4	0.70
43	PARKER RANCH #15-4	100	332.868	35.179	1.50	1	0	111.744	485.648	9.4	107	19	0.86
44	PARKER RANCH #15-8	300	404.556	70.757	1.50	3	0	430.791	1,204.135	3.8	96	15	1.82
45	PARKER RANCH #22-7	400	201.136	35.179	1.50	2	0	154.019	290.586	1.4	40	3	0.52
46	PITMAN #13-4	400	404.556	30.590	2.00	2	0	349.520	945.431	2.8	55	9	1.40
47	PITMAN #18-2	300	606.833	19.564	2.00	2	0	401.943	897.559	5.7	62	11	1.50
48	R. H. RANCH #1	500	484.048	32.723	1.75	1	0	576.371	798.285	2.7	56	7	1.49
49	SHAEFFER #12-6	300	583.199	15.209	2.00	1	0	327.852	623.486	5.5	54	9	1.17
50	SHAEFFER #12-8	200	221.911	20.114	2.00	1	0	84.293	334.832	3.1	47	6	0.56
51	SHAEFFER #18-5	300	506.250	22.500	2.00	1	0	412.993	823.535	4.7	61	11	1.39
52	SHAEFFER J. #1	100	115.000	74.943	1.50	0	323.219	818.356	477.541	3.2	14	92	0.54
53	SHIDELER #25-10	300	136.420	21.254	2.00	0	0	120.659	242.049	1.3	31	3	0.36
54	YOUBERG RU #11-7	300	2,702.500	23.829	1.50	2	0	1,301.525	2,383.018	25.3	145	35	4.97

* 0 Poor, 1 Fair, 2 Good, 3 Excellent

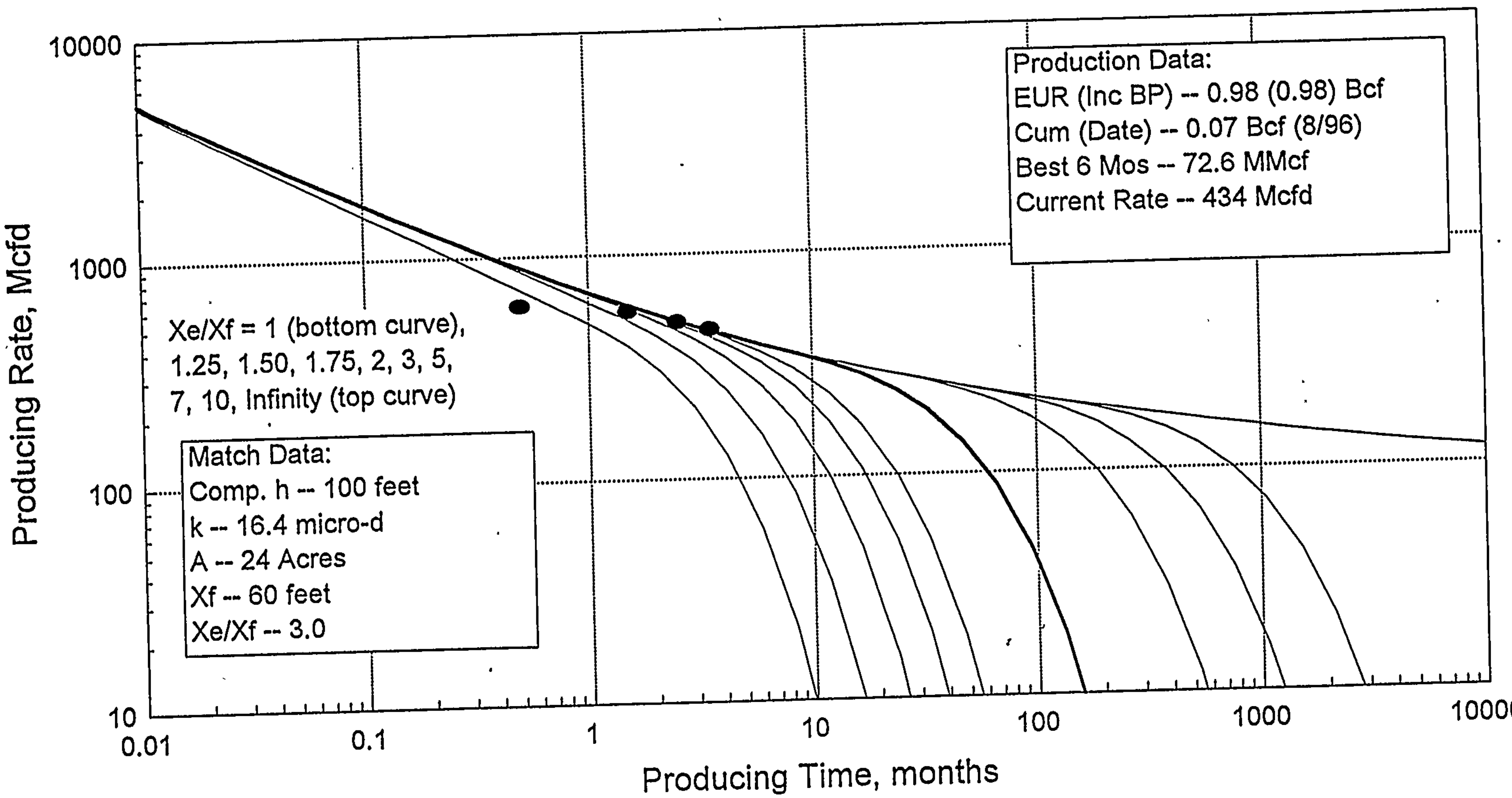
ARCO-Exxon #1-36

(Ye/Xe=1)



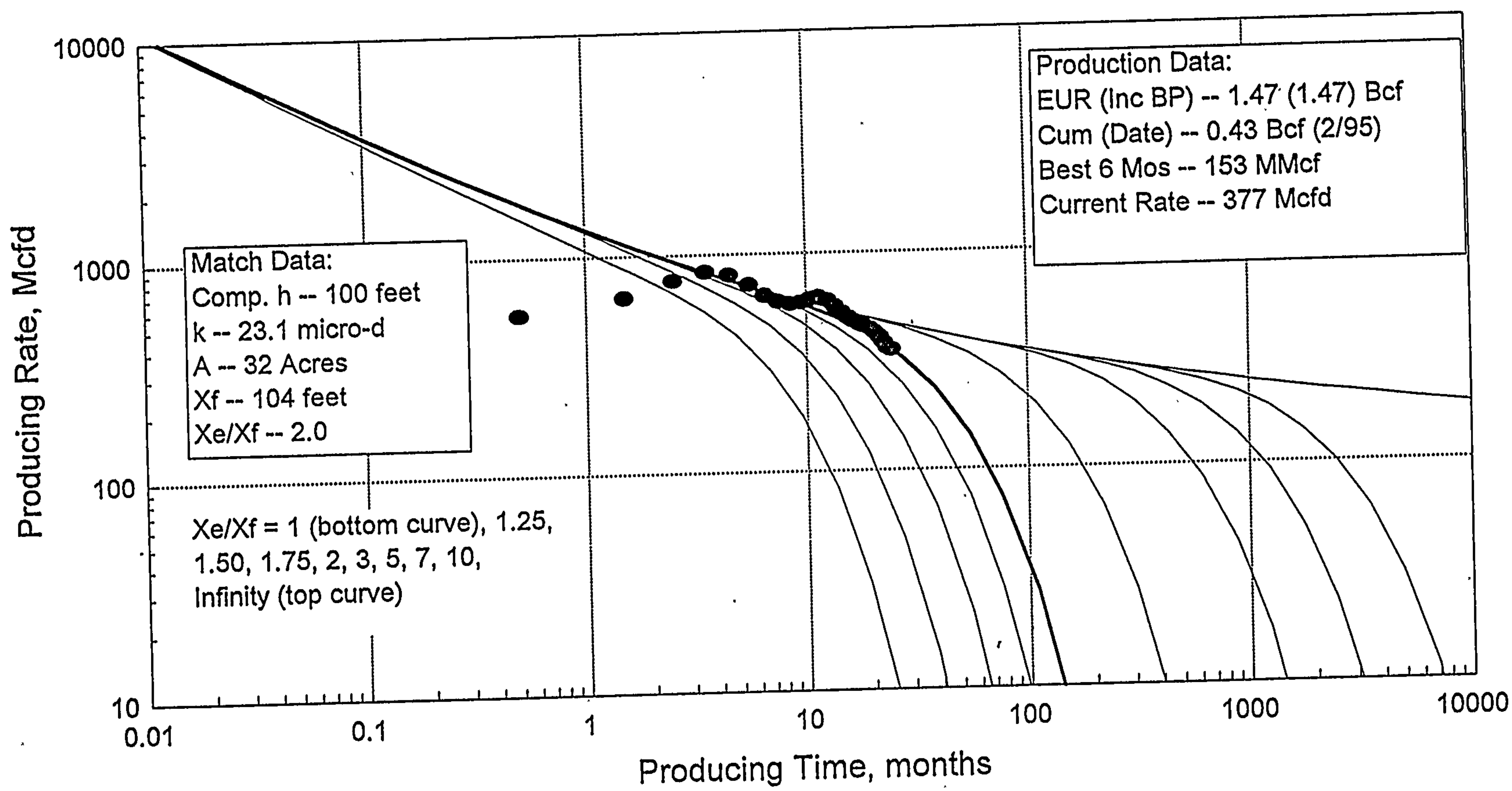
Bennet #32-7

(Ye/Xe=1)



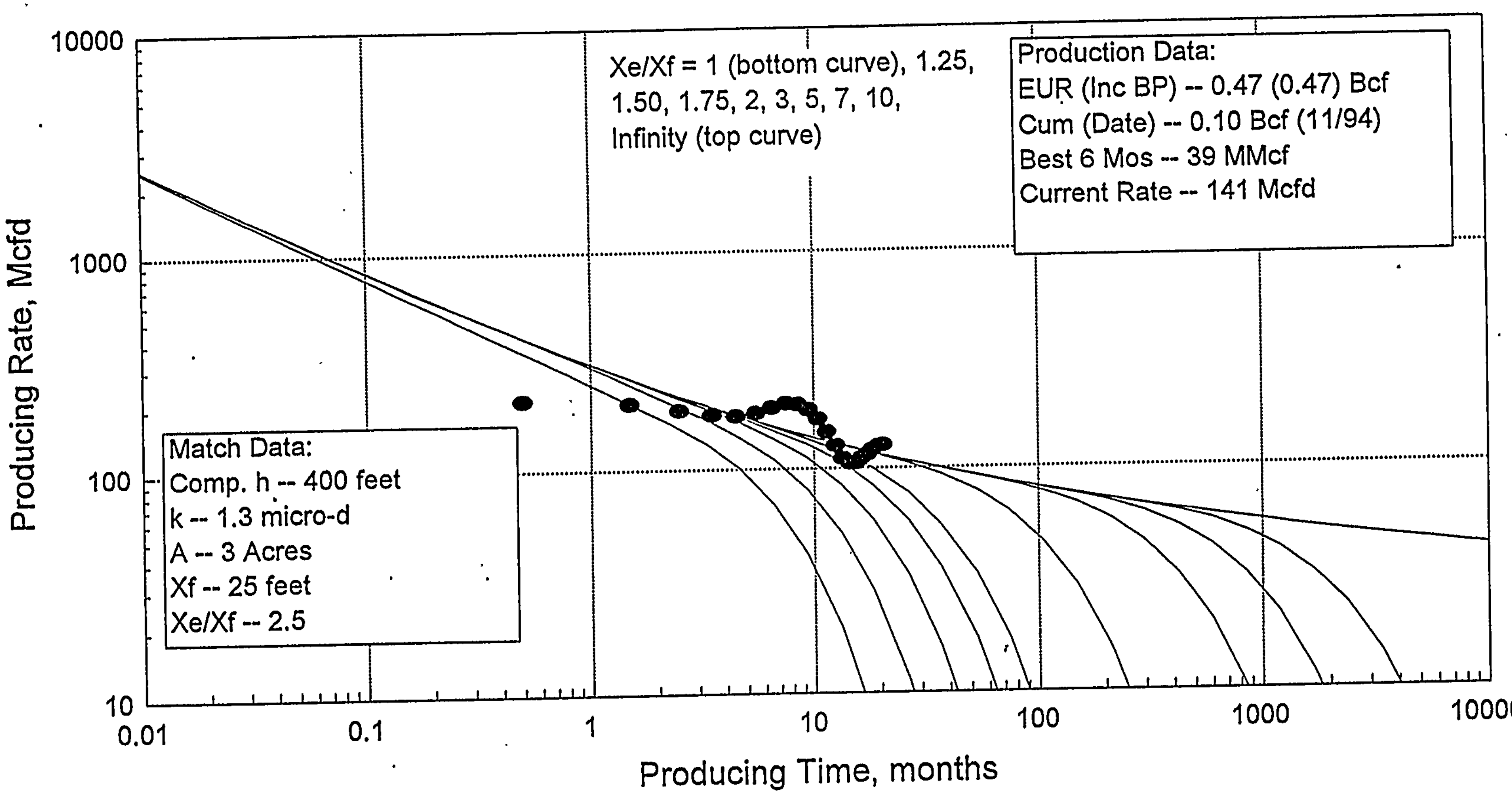
Bennet #32-10

(Ye/Xe=1)



Benzel #1-12

(Ye/Xe=1)



Benzel #26-16

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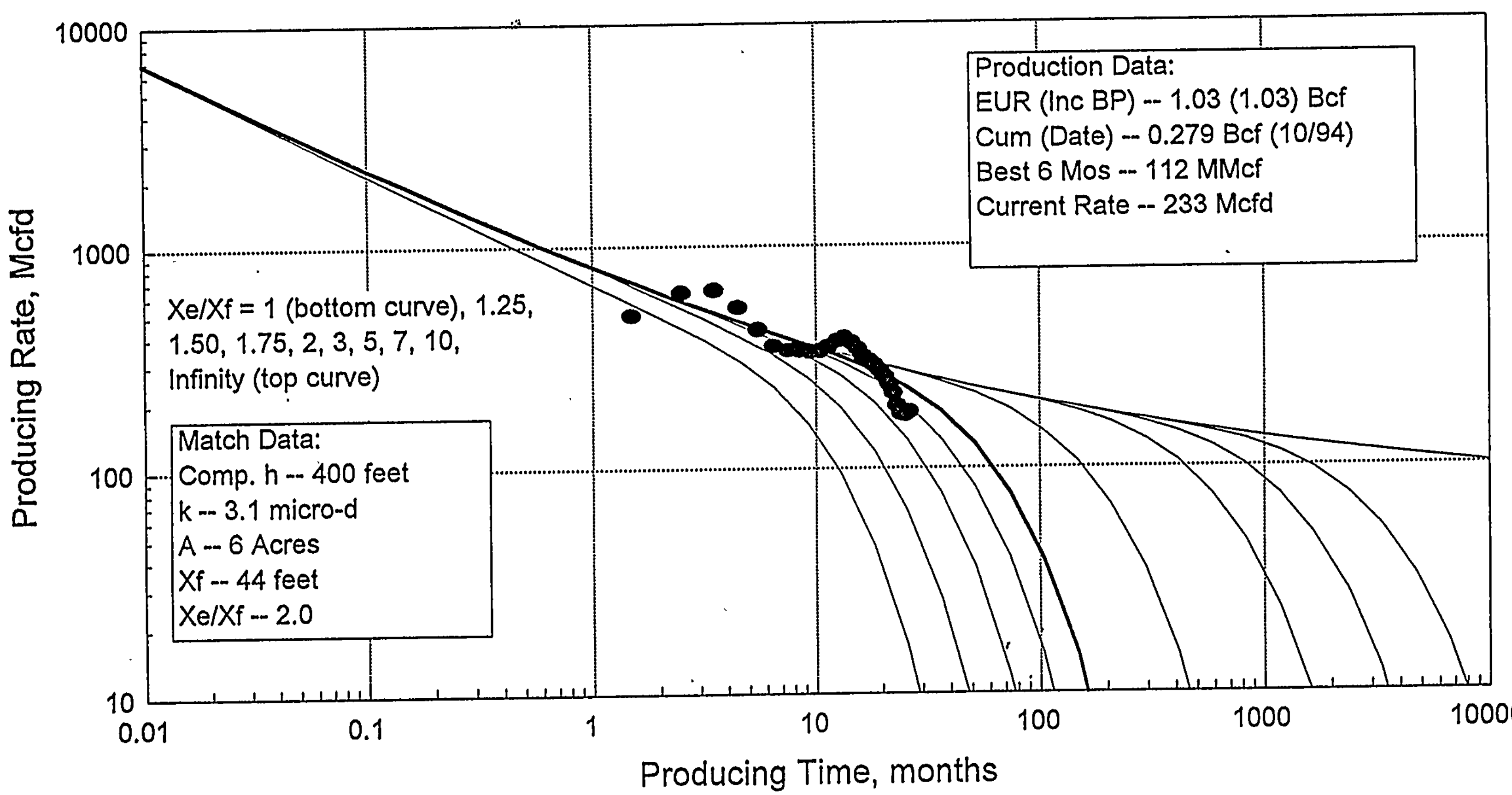
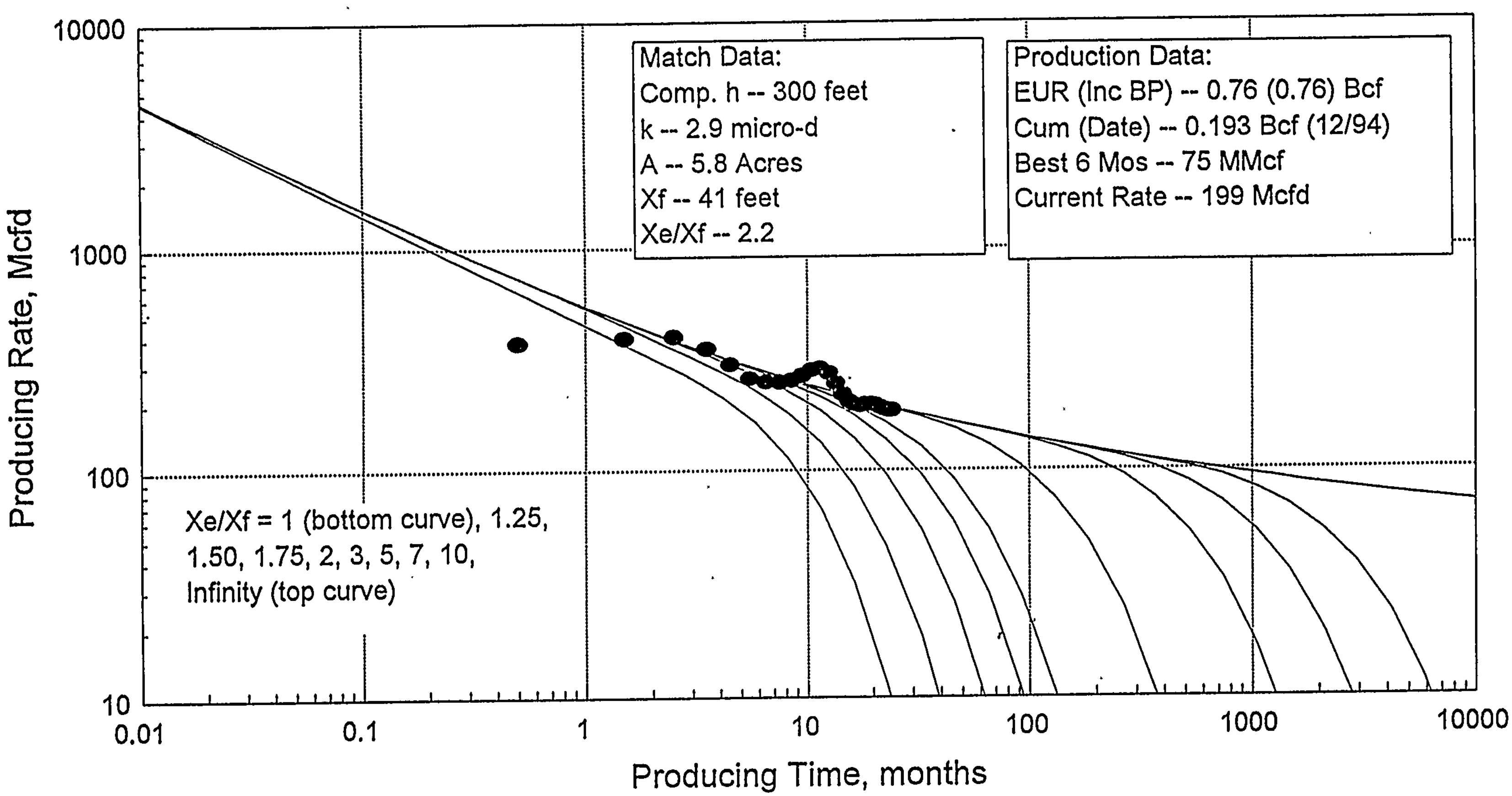
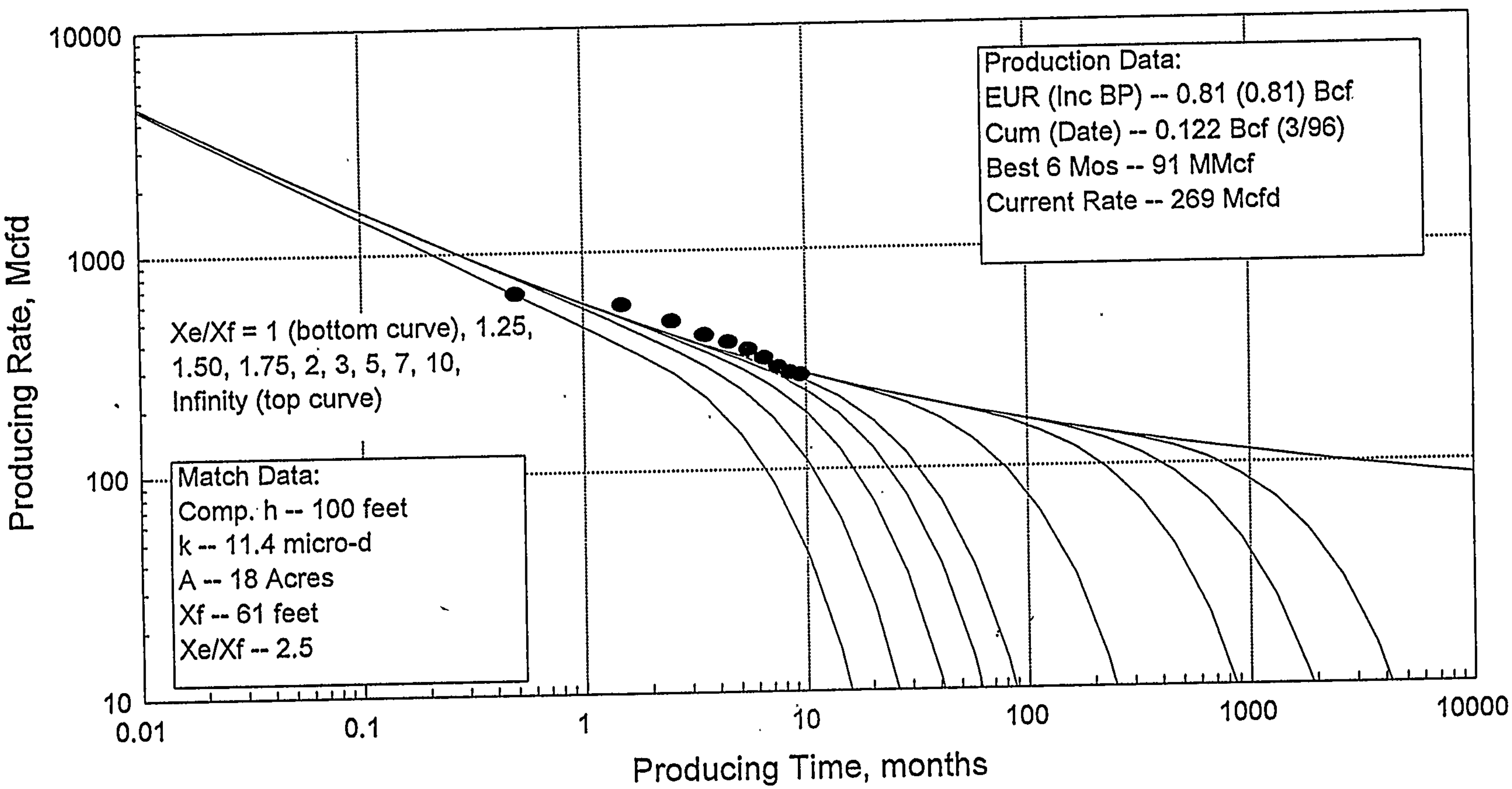


Benzel #36-16

(Ye/Xe=1)

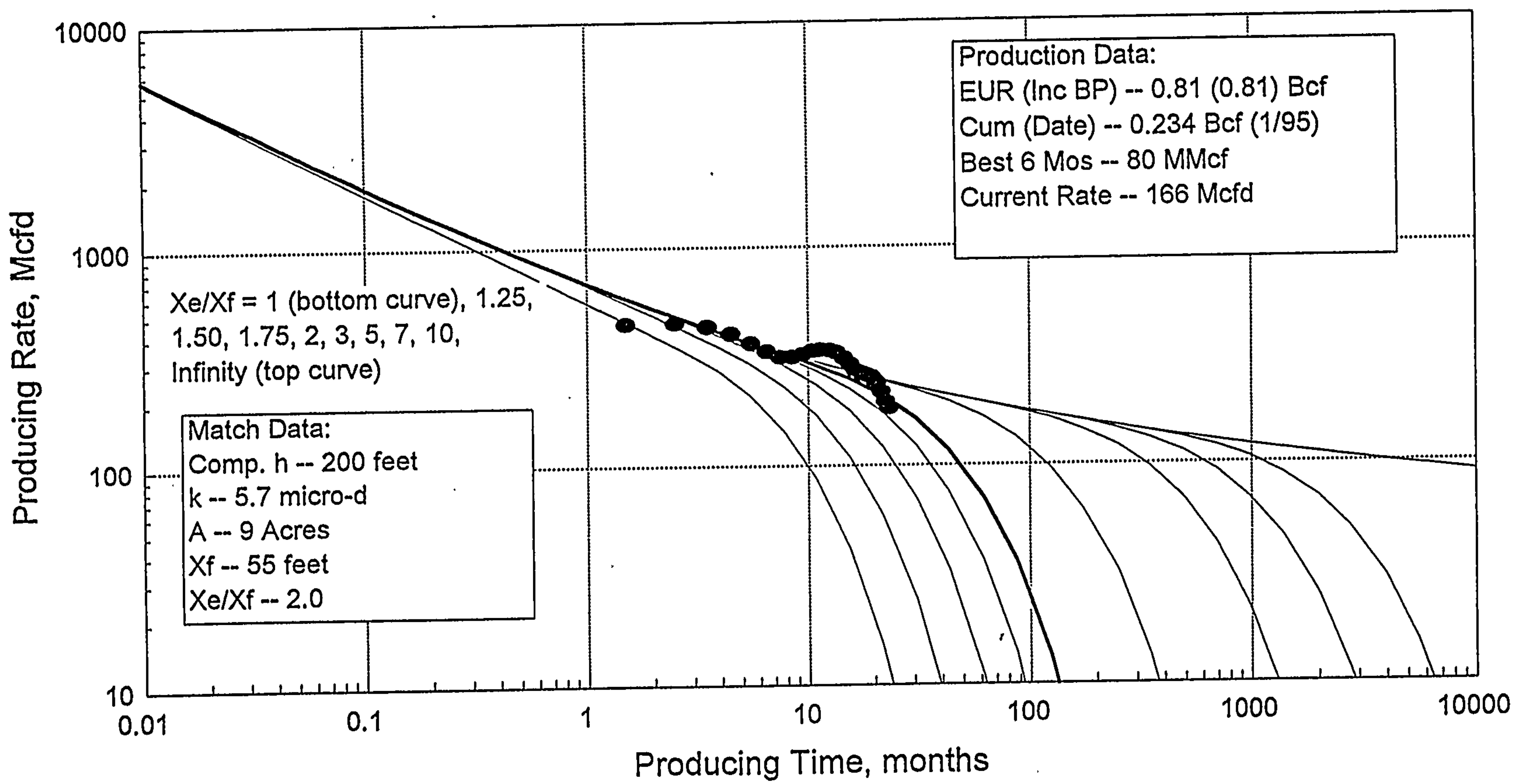


BJM #6-16
(Ye/Xe=1)



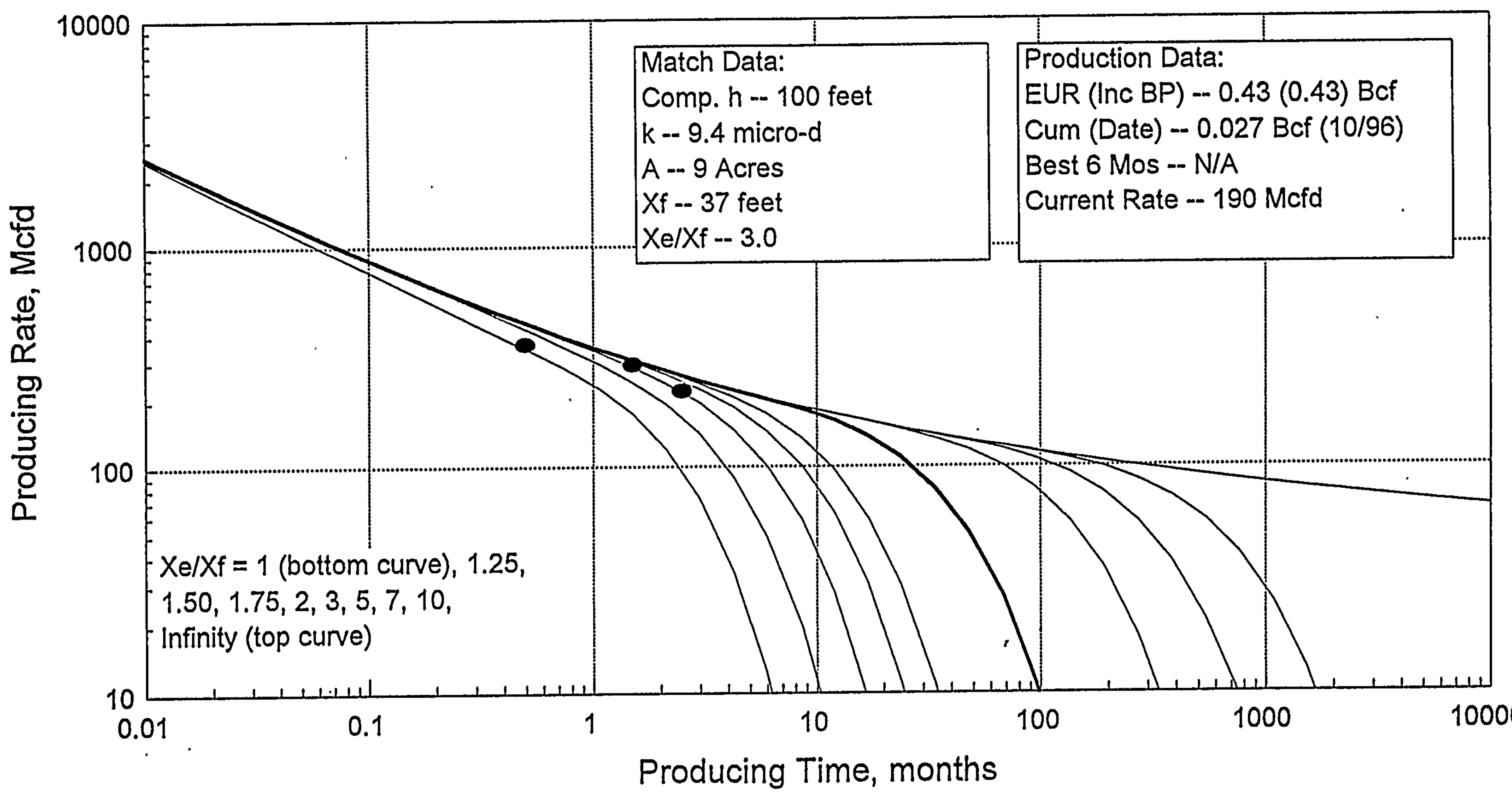
Cook #12-16

(Ye/Xe=1)



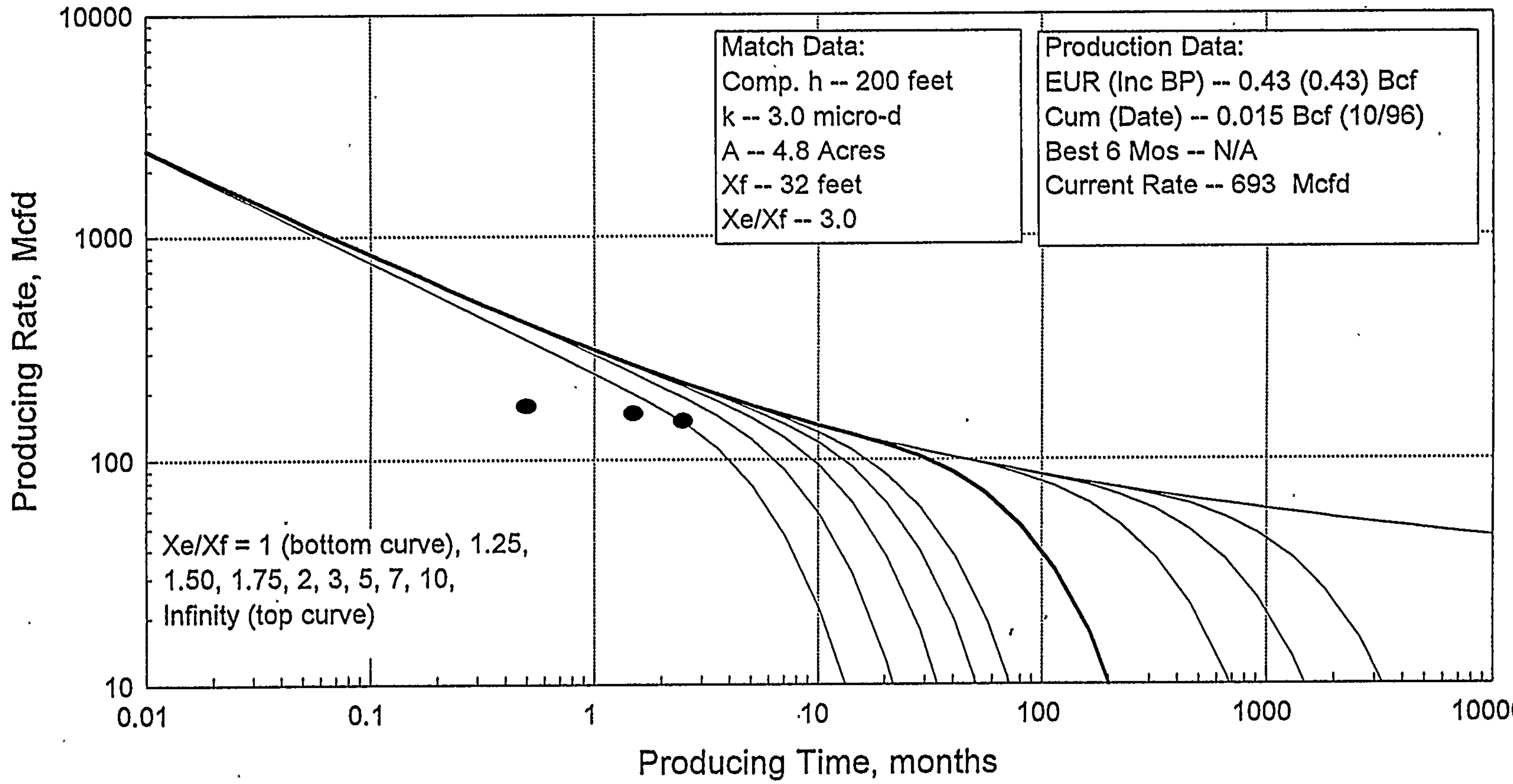
Couey #5-10

(Ye/Xe=1)



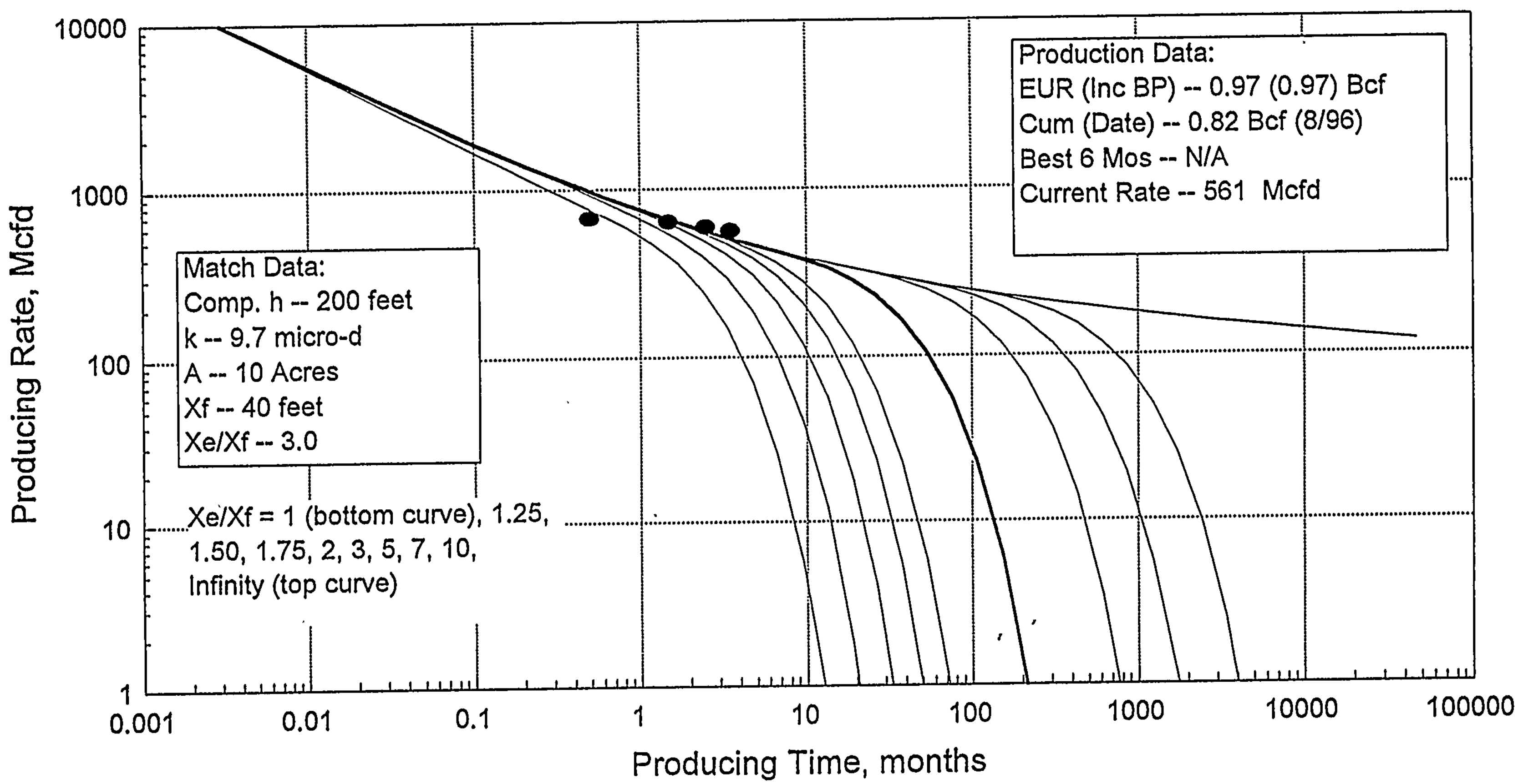
Couey #5-12

(Ye/Xe=1)



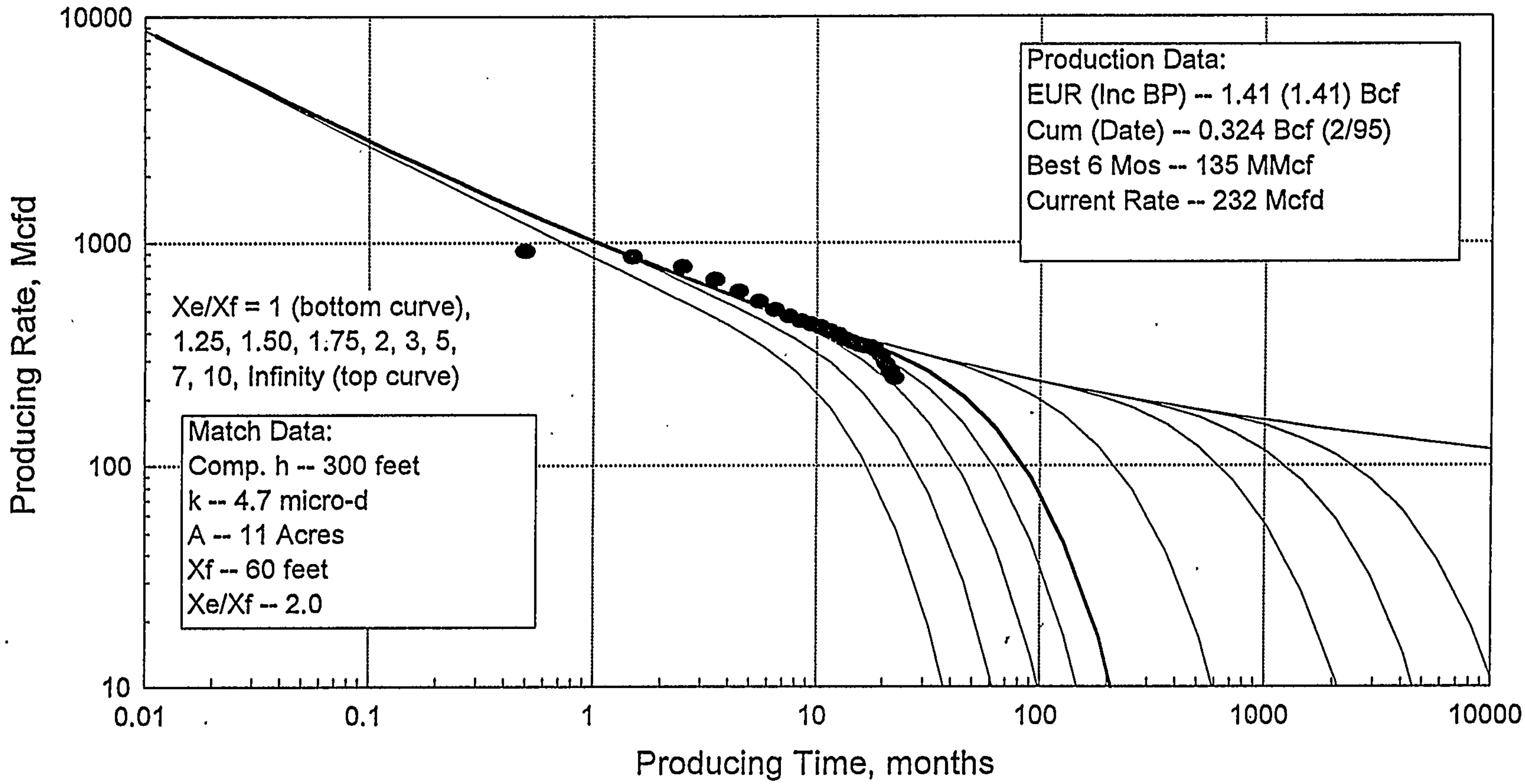
Couey #5-14

(Ye/Xe=1)



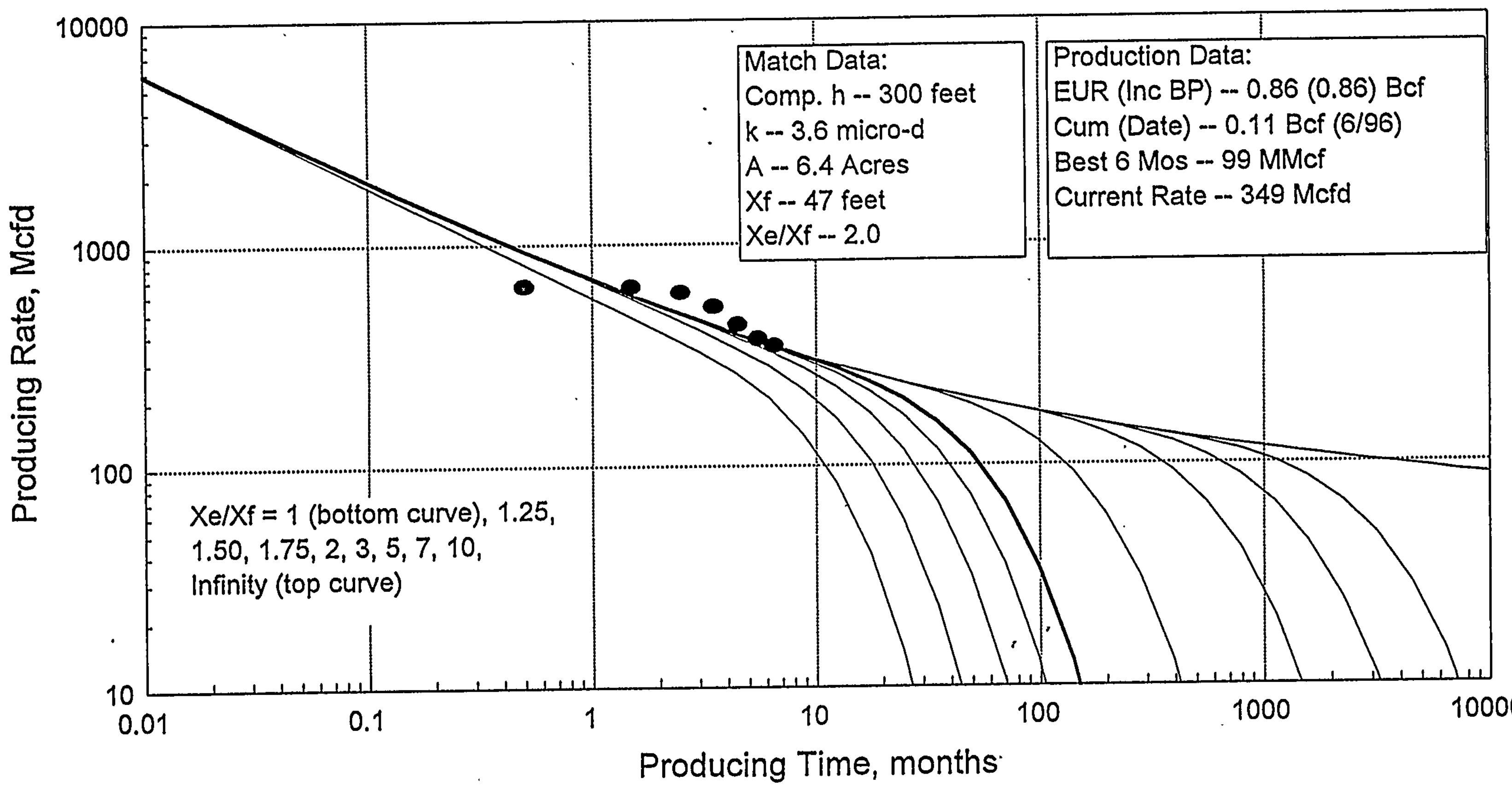
Couey #13-16

(Ye/Xe=1)



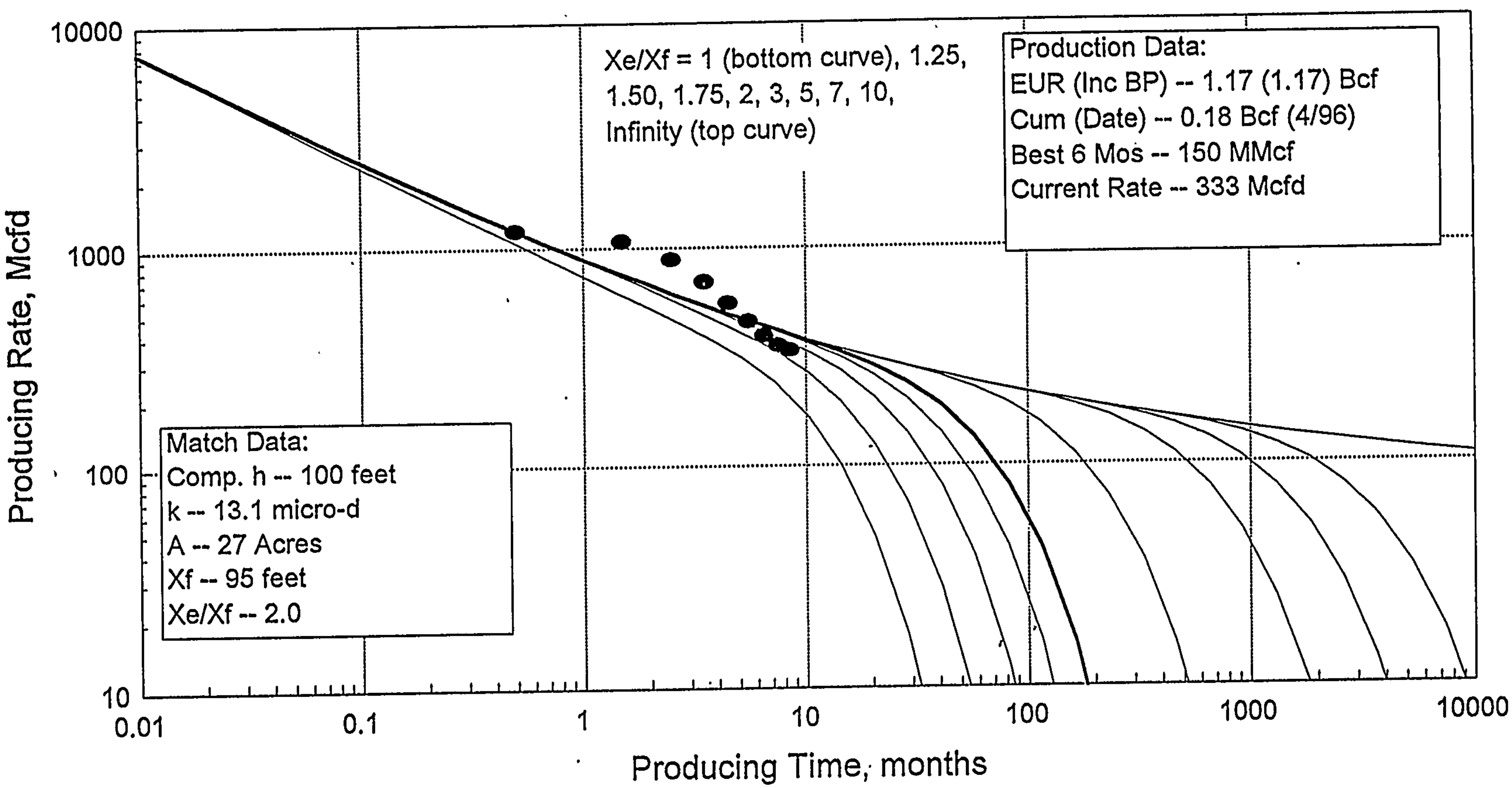
Couey #18-10

(Ye/Xe=1)



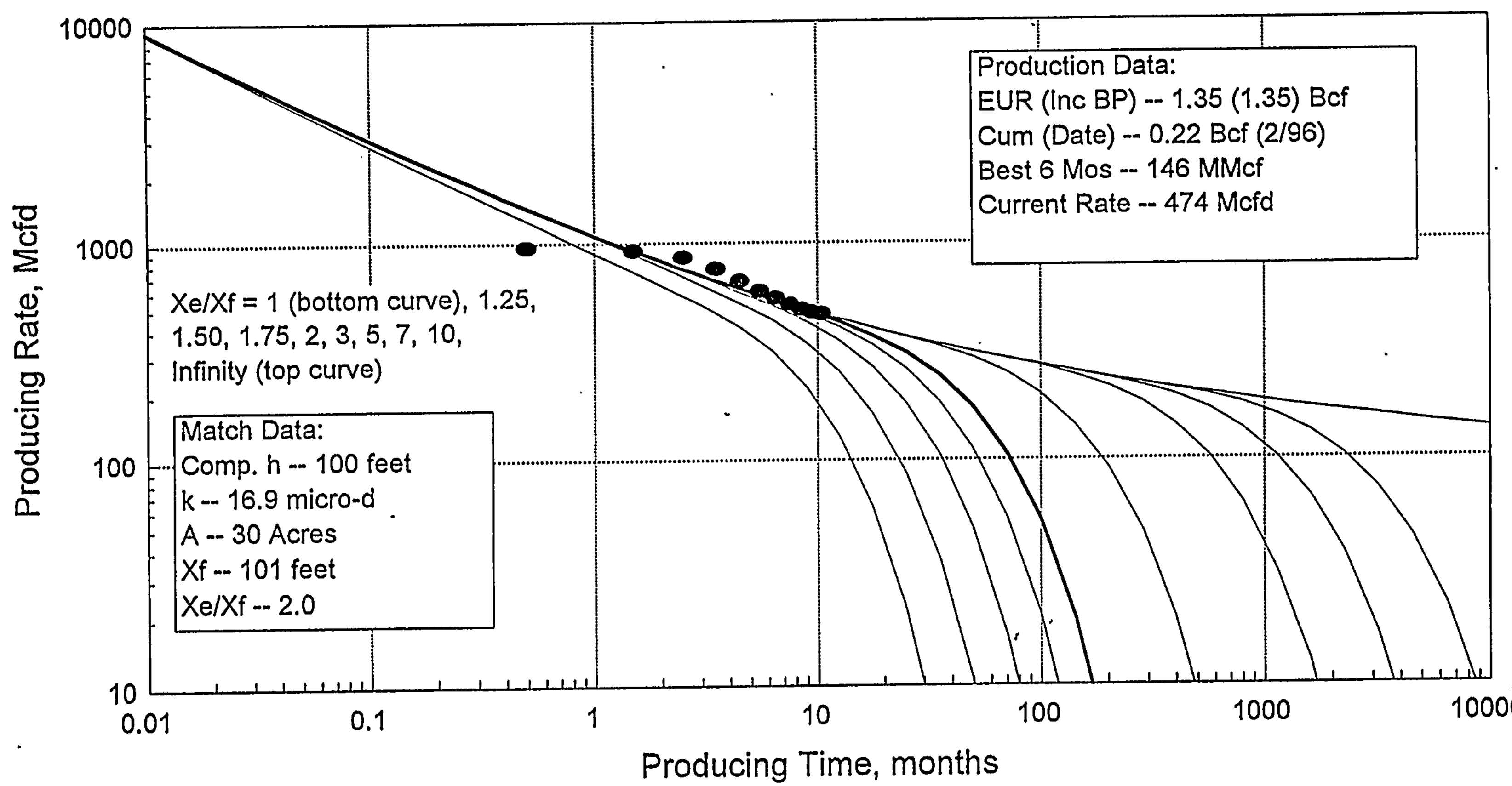
Couey #32-14

(Ye/Xe=1)



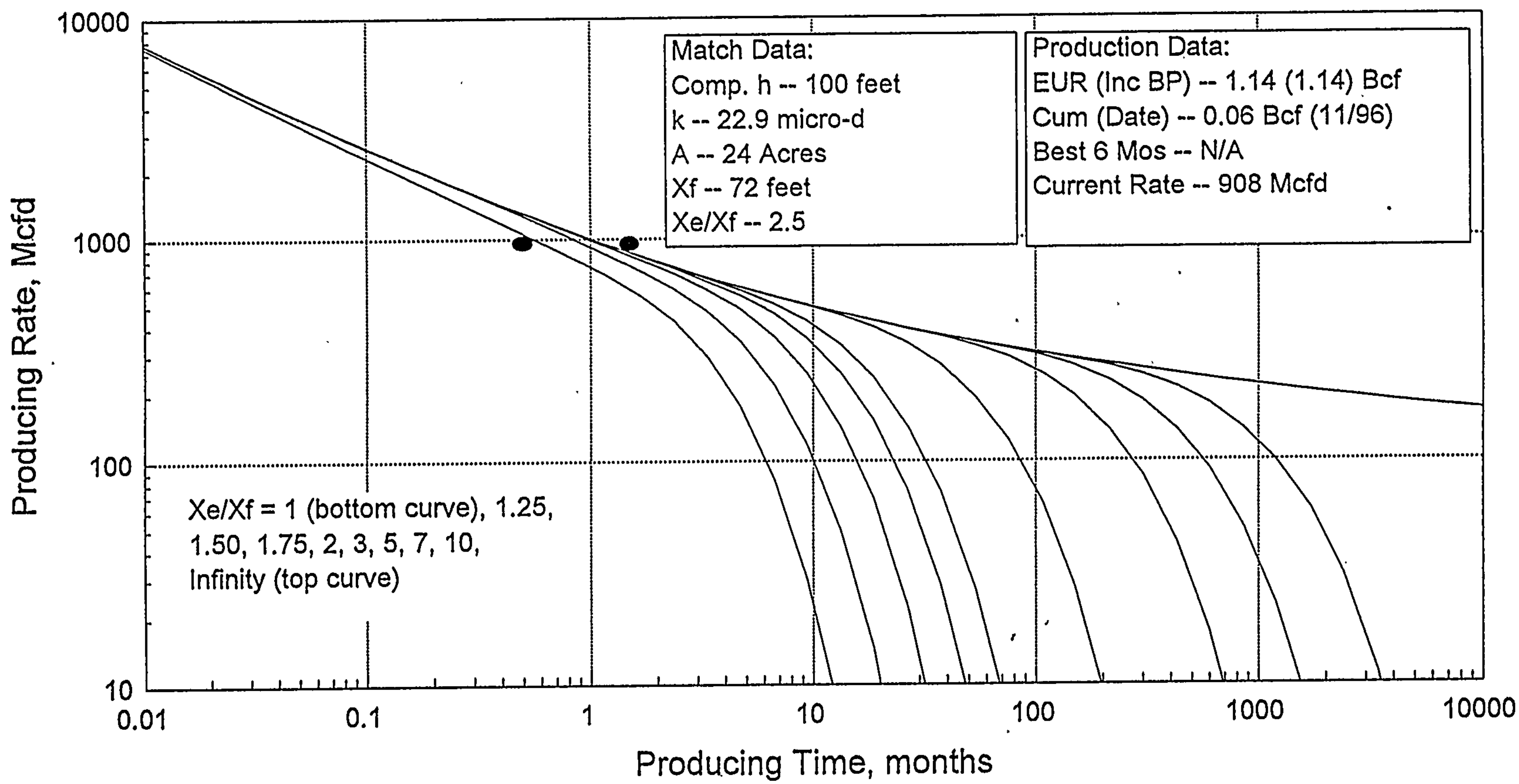
Couey #32-15

(Ye/Xe=1)



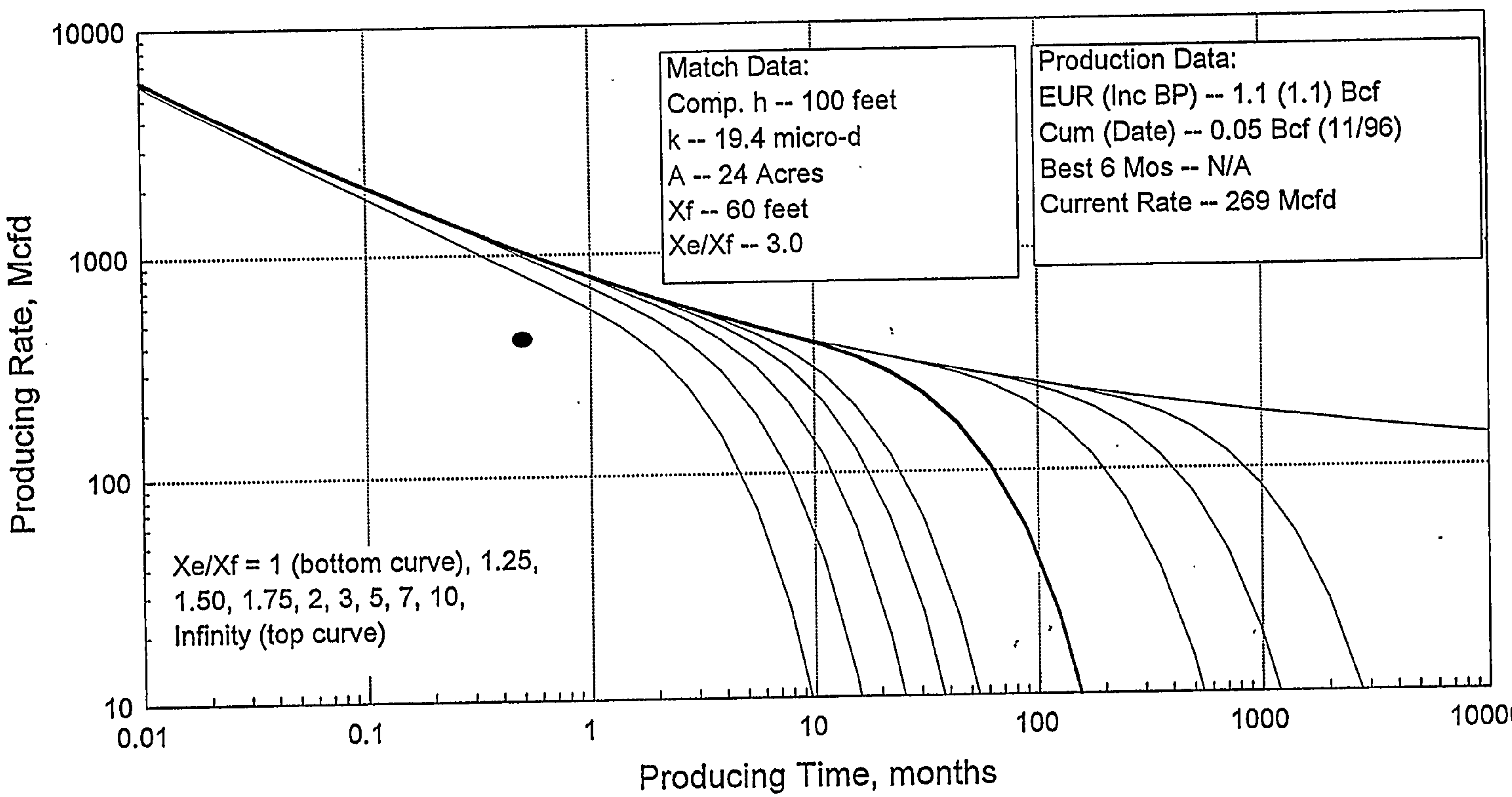
Dunn #4-11

(Ye/Xe=1)



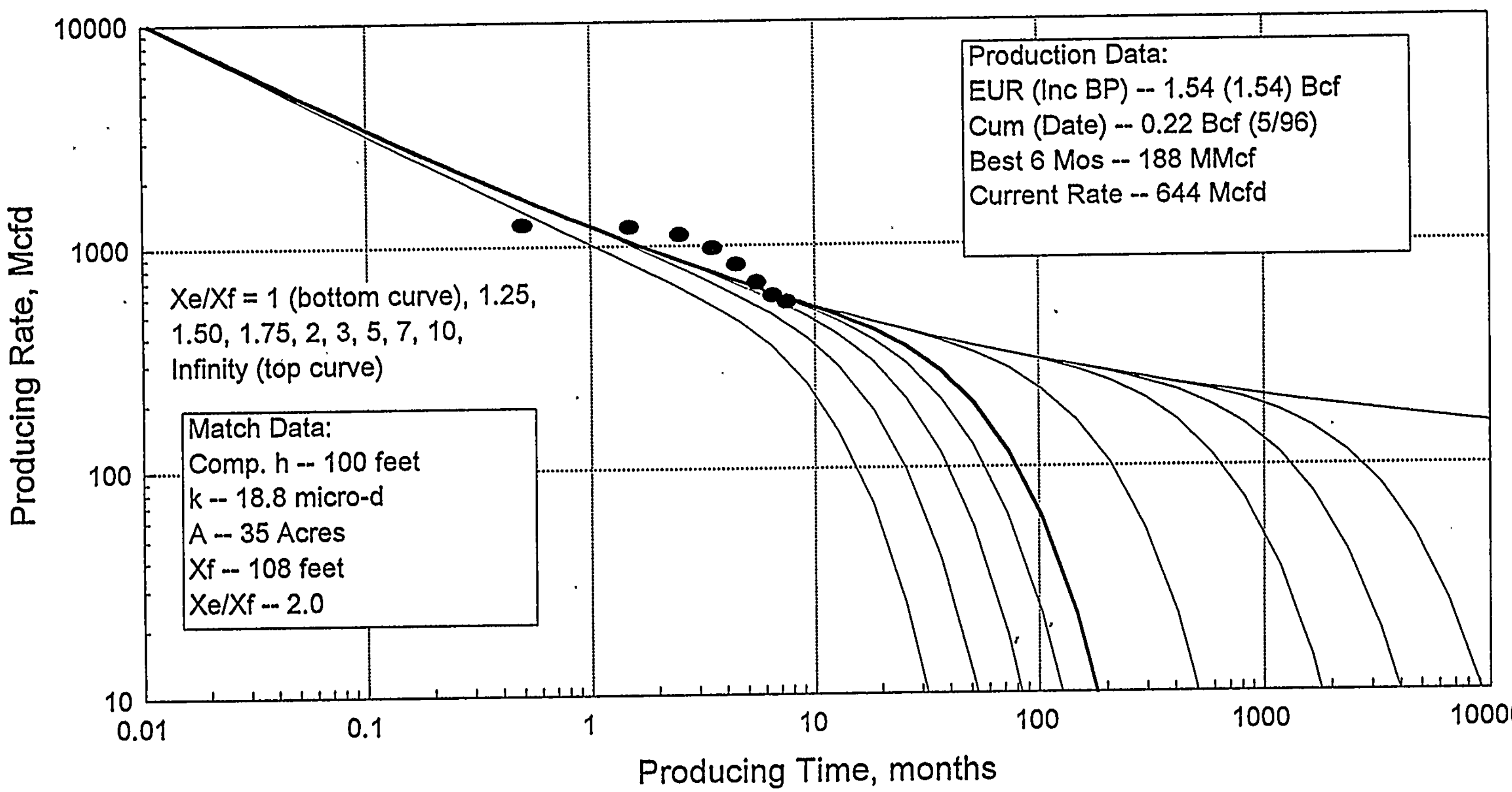
Dunn #4-12

(Ye/Xe=1)



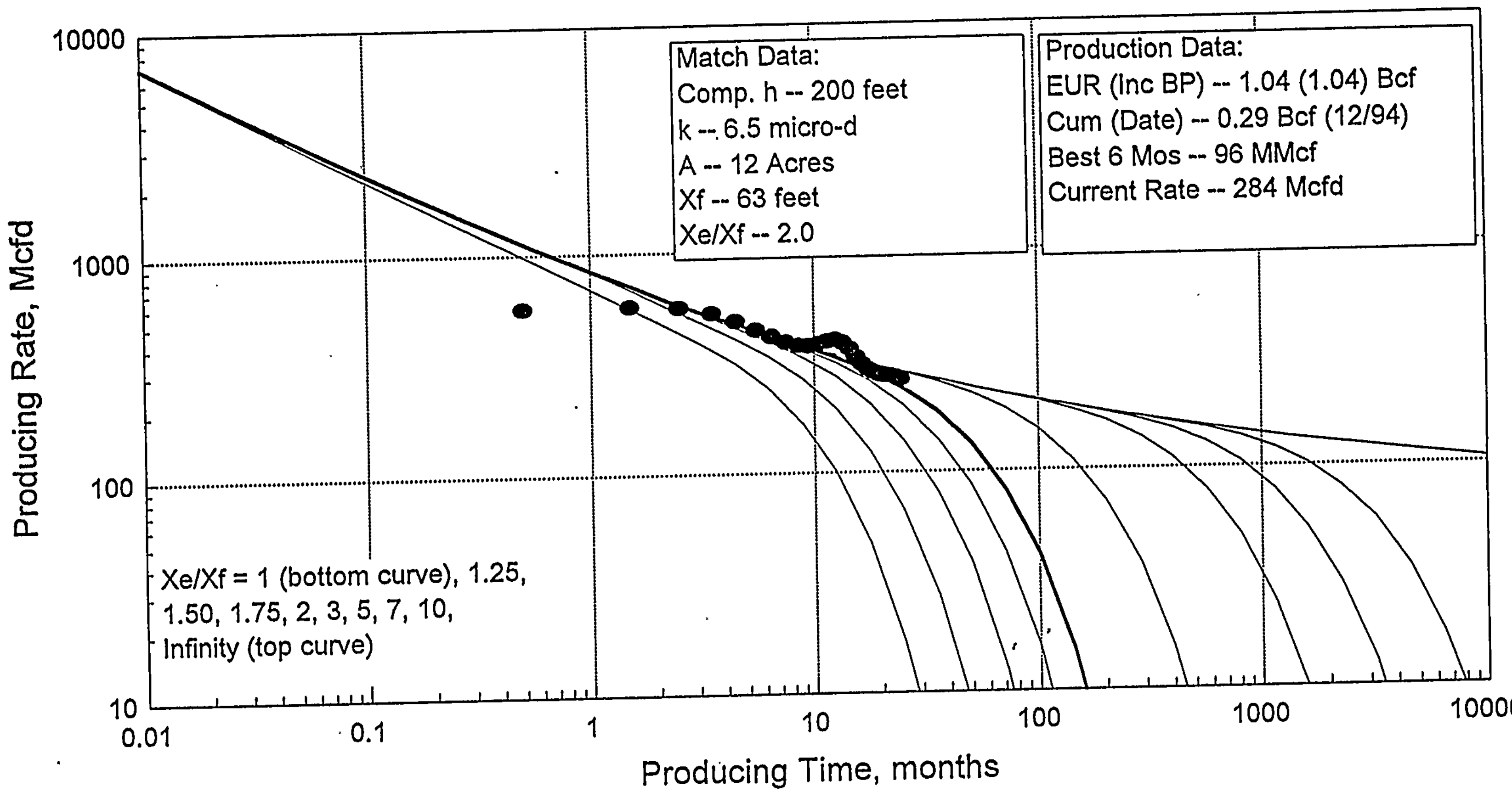
Dunn #5-9

(Ye/Xe=1)



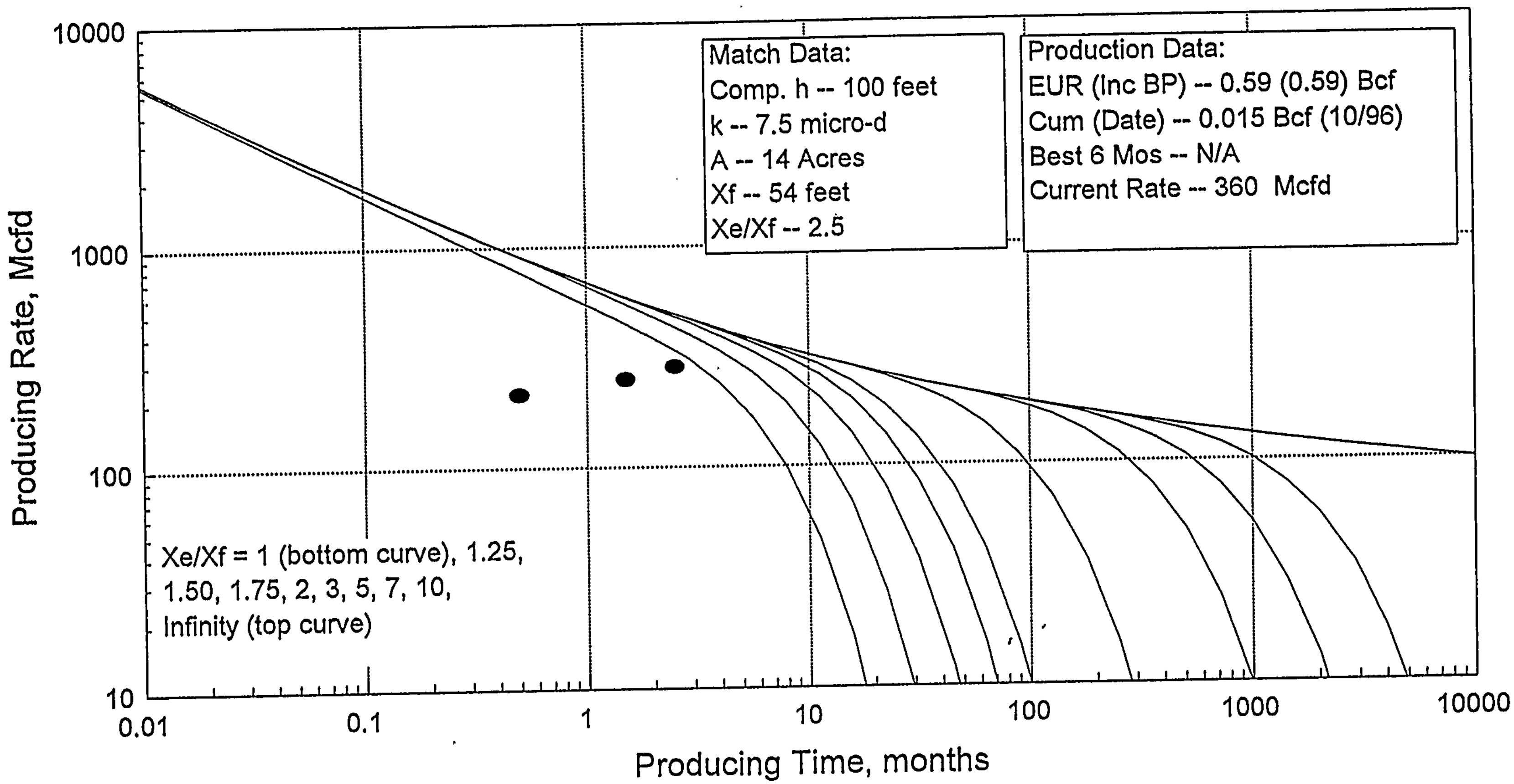
Dunn #9-2

(Ye/Xe=1)



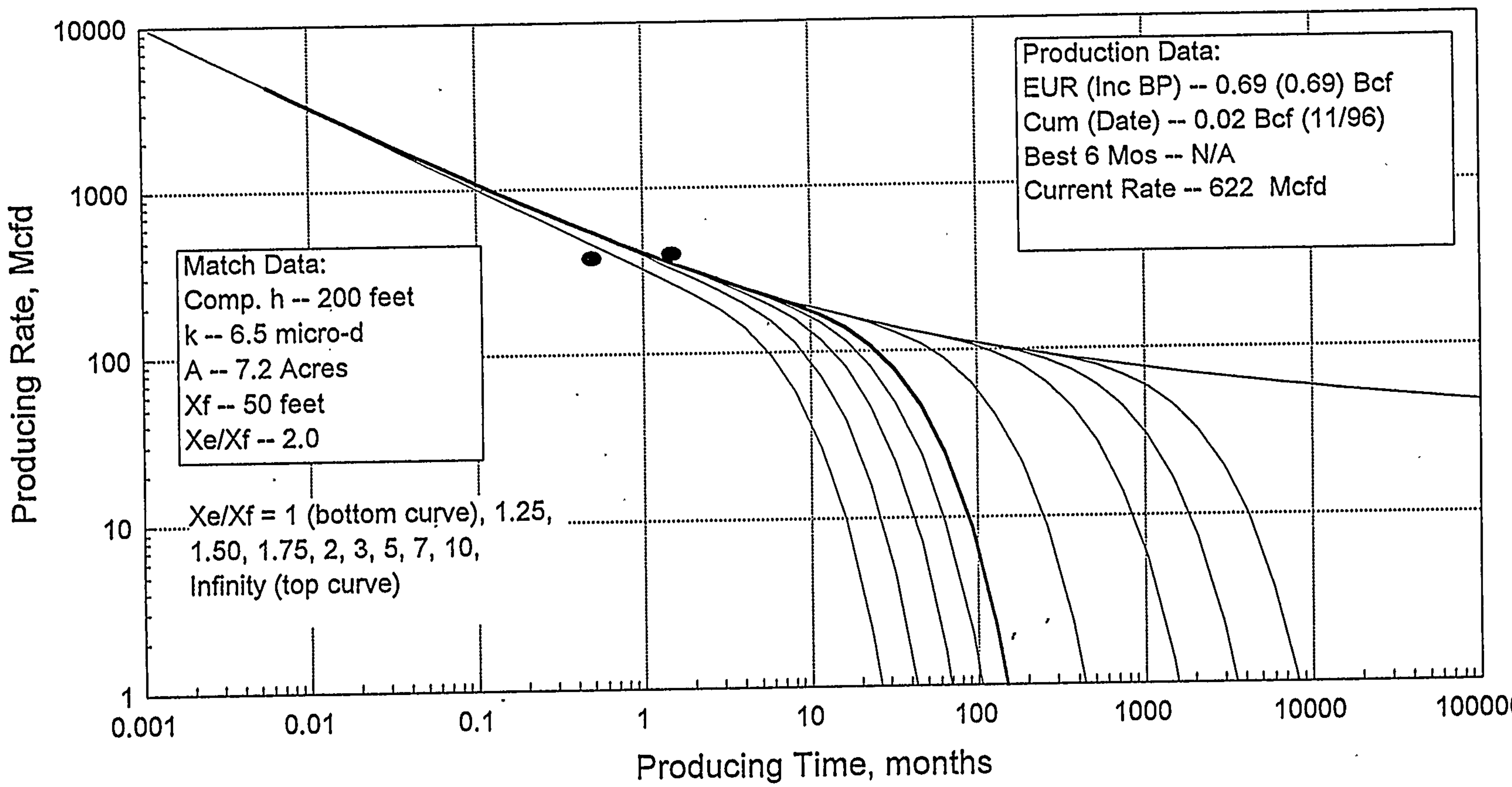
Dunn #32-16

(Ye/Xe=1)



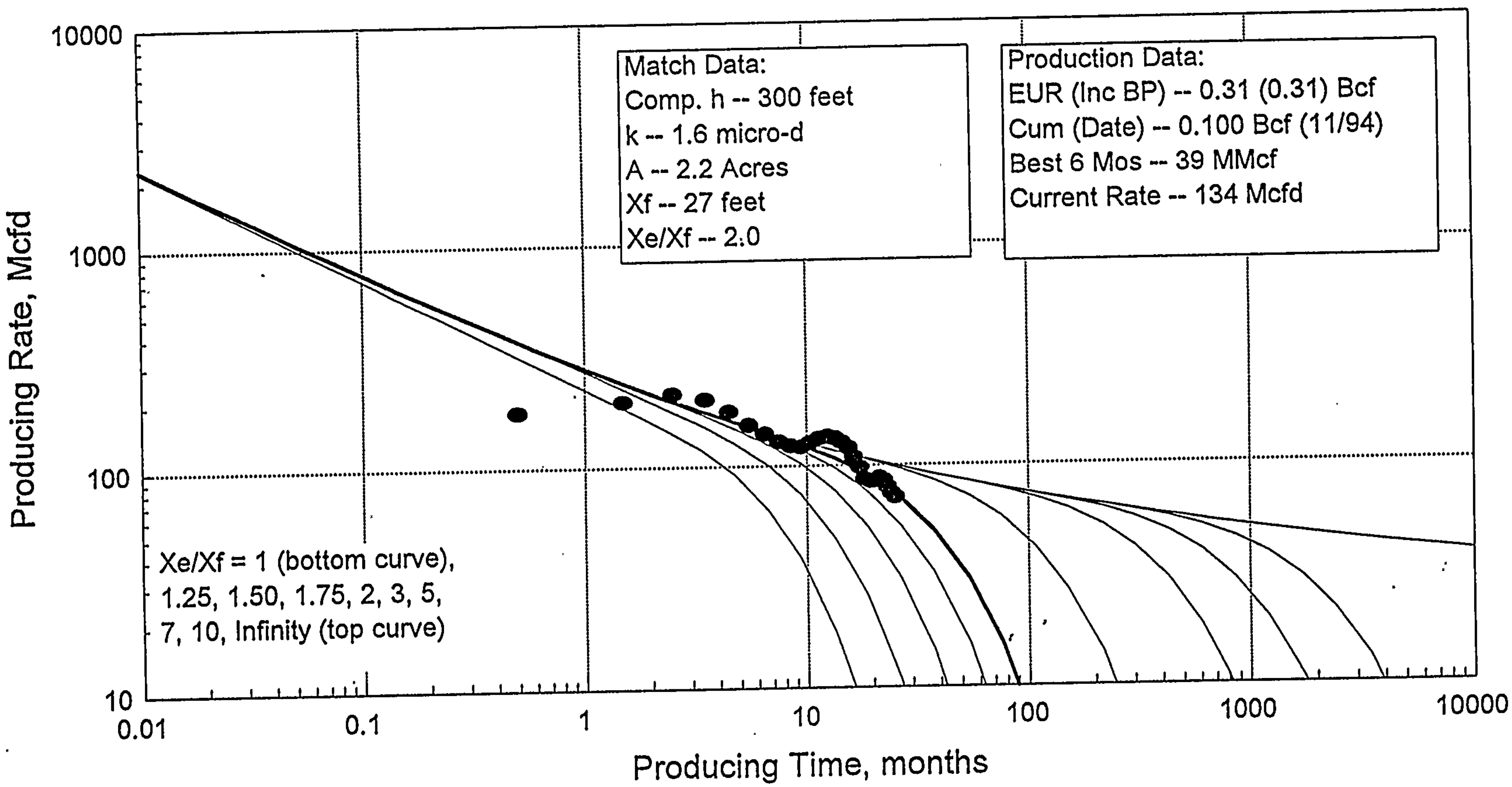
Graham #13-1

(Ye/Xe=1)



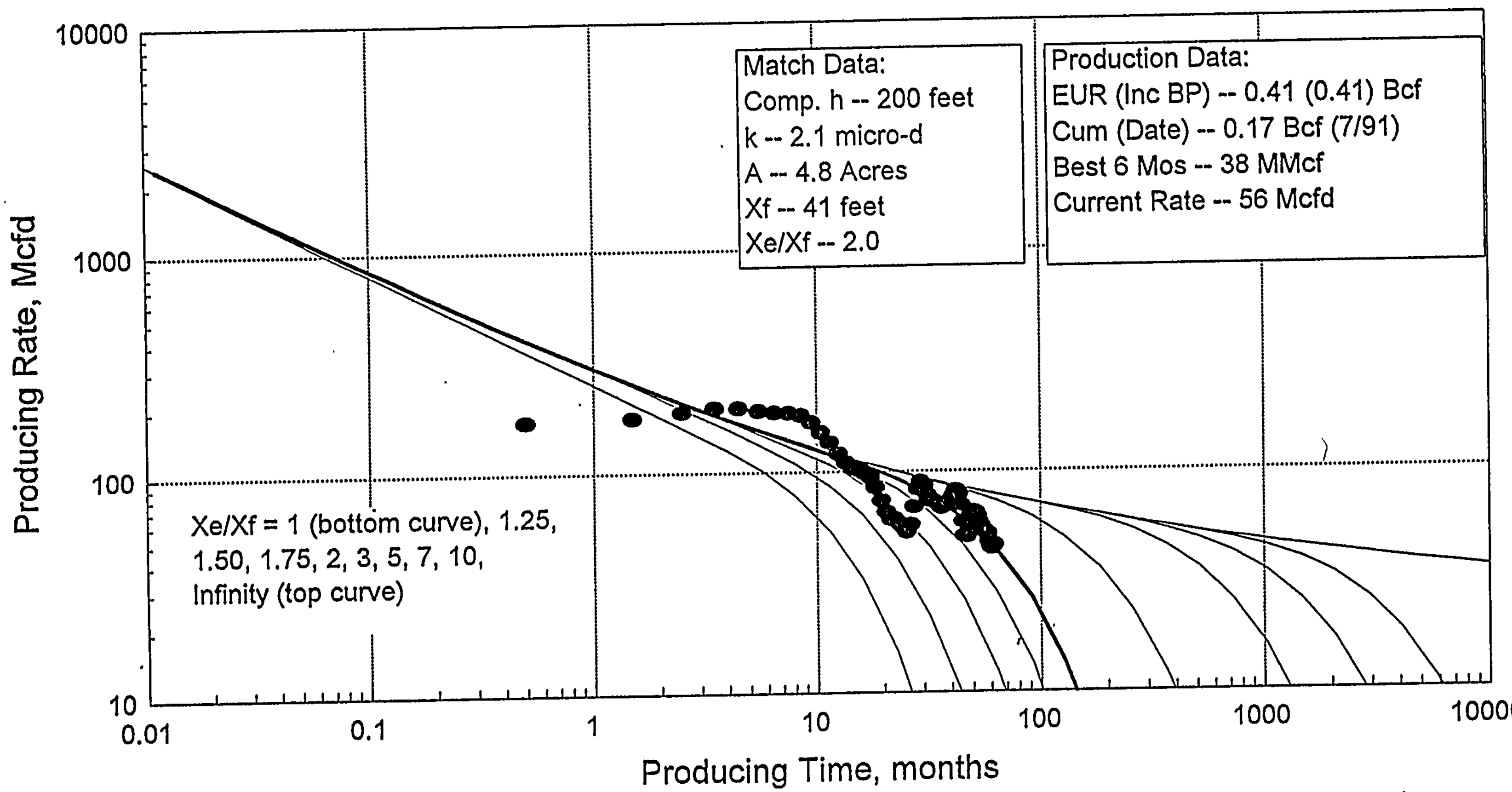
Grass Mesa Ranch #27-4

(Ye/Xe=1)

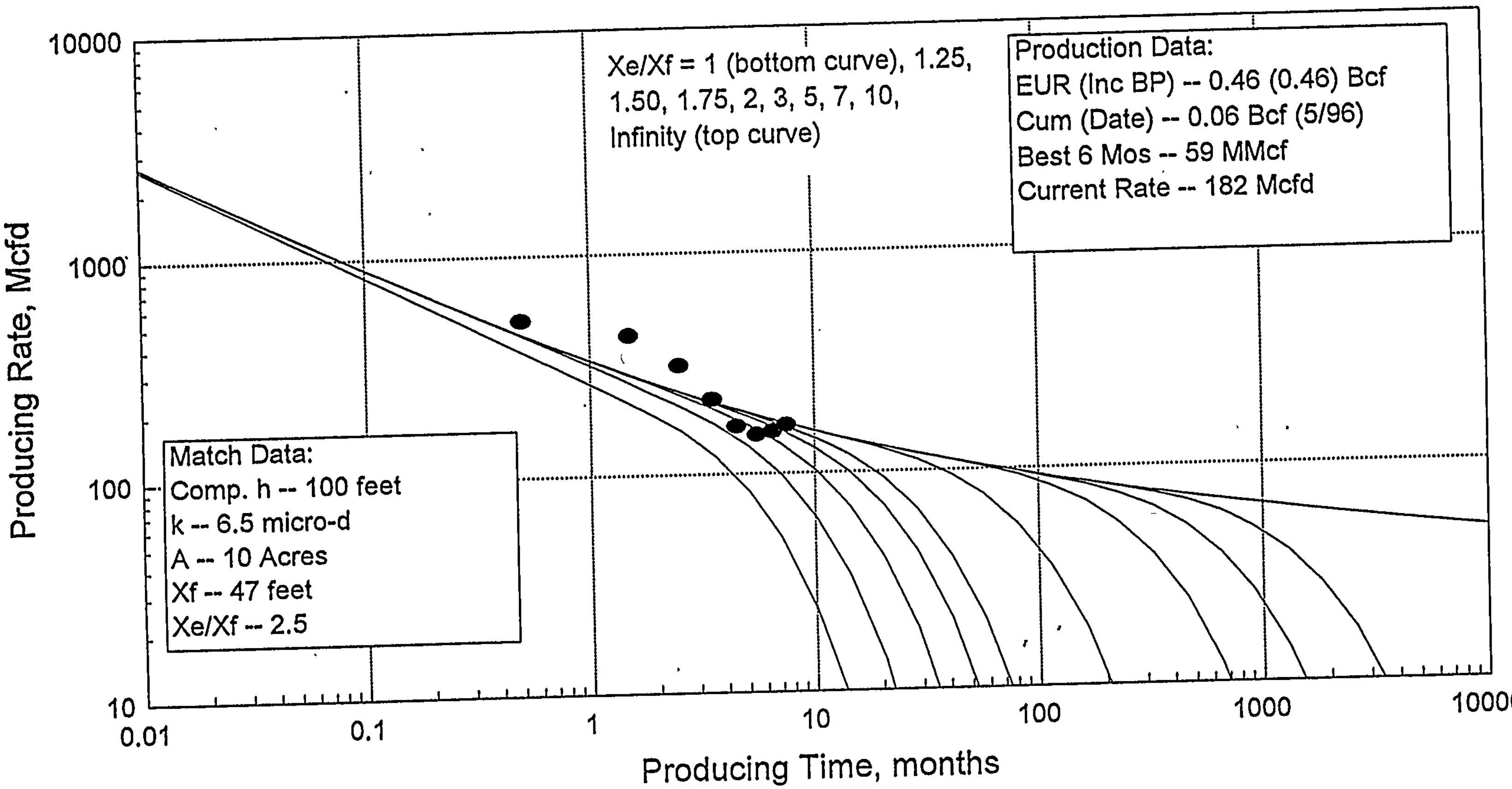


Grass Mesa Ranch #33-1

(Ye/Xe=1)

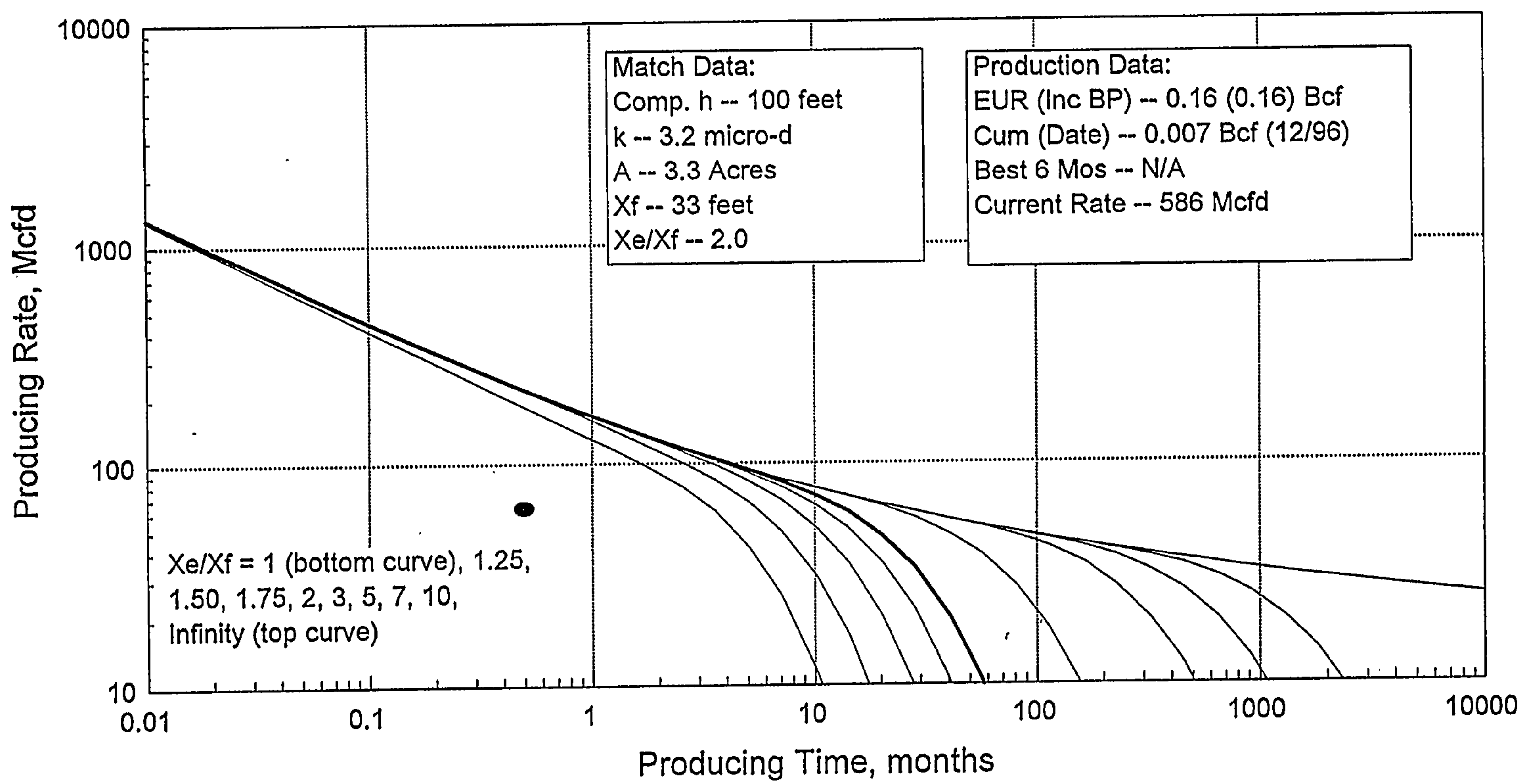


Hill #9-12
(Ye/Xe=1)



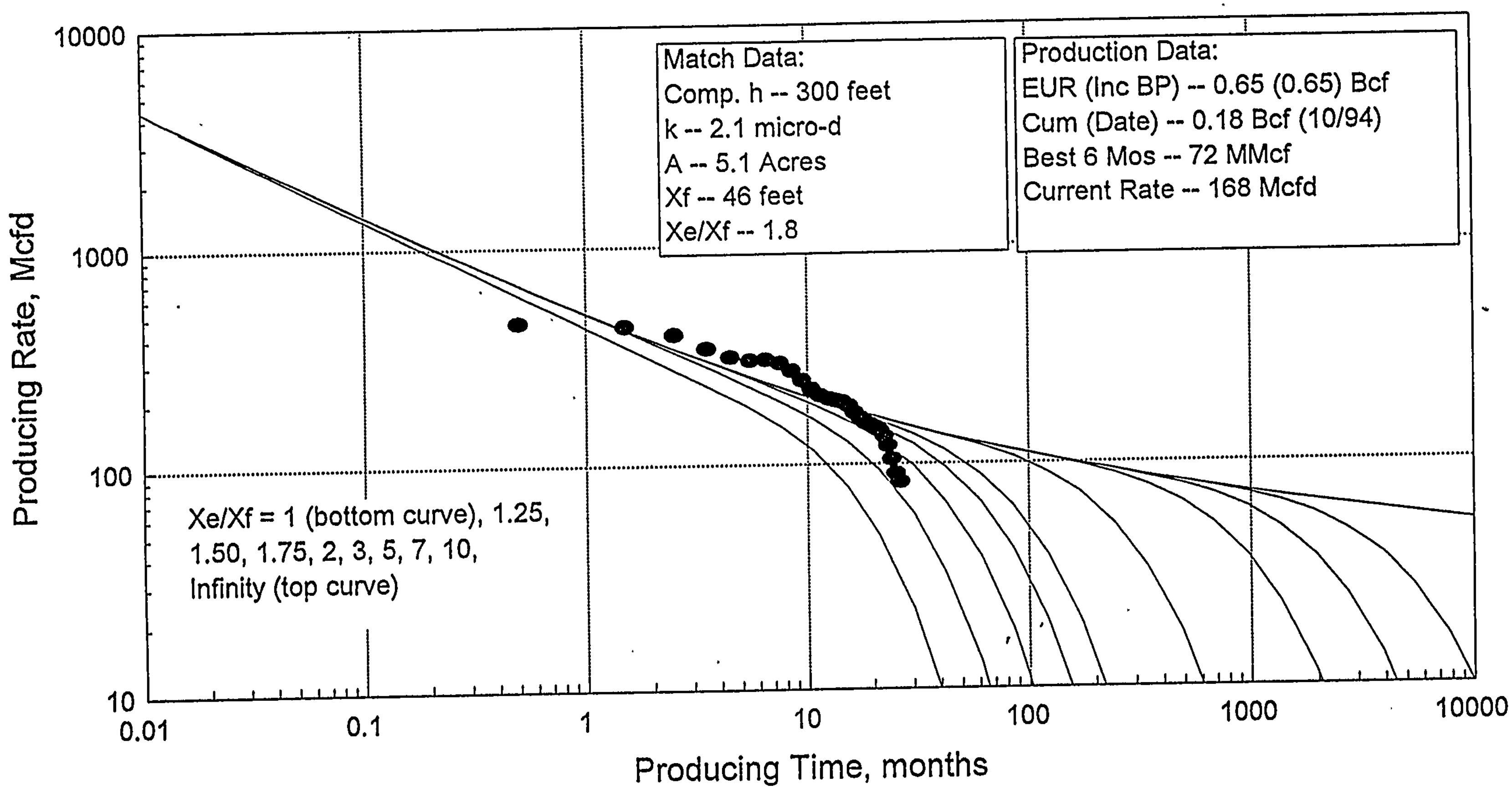
HMU Federal #5-16

(Ye/Xe=1)



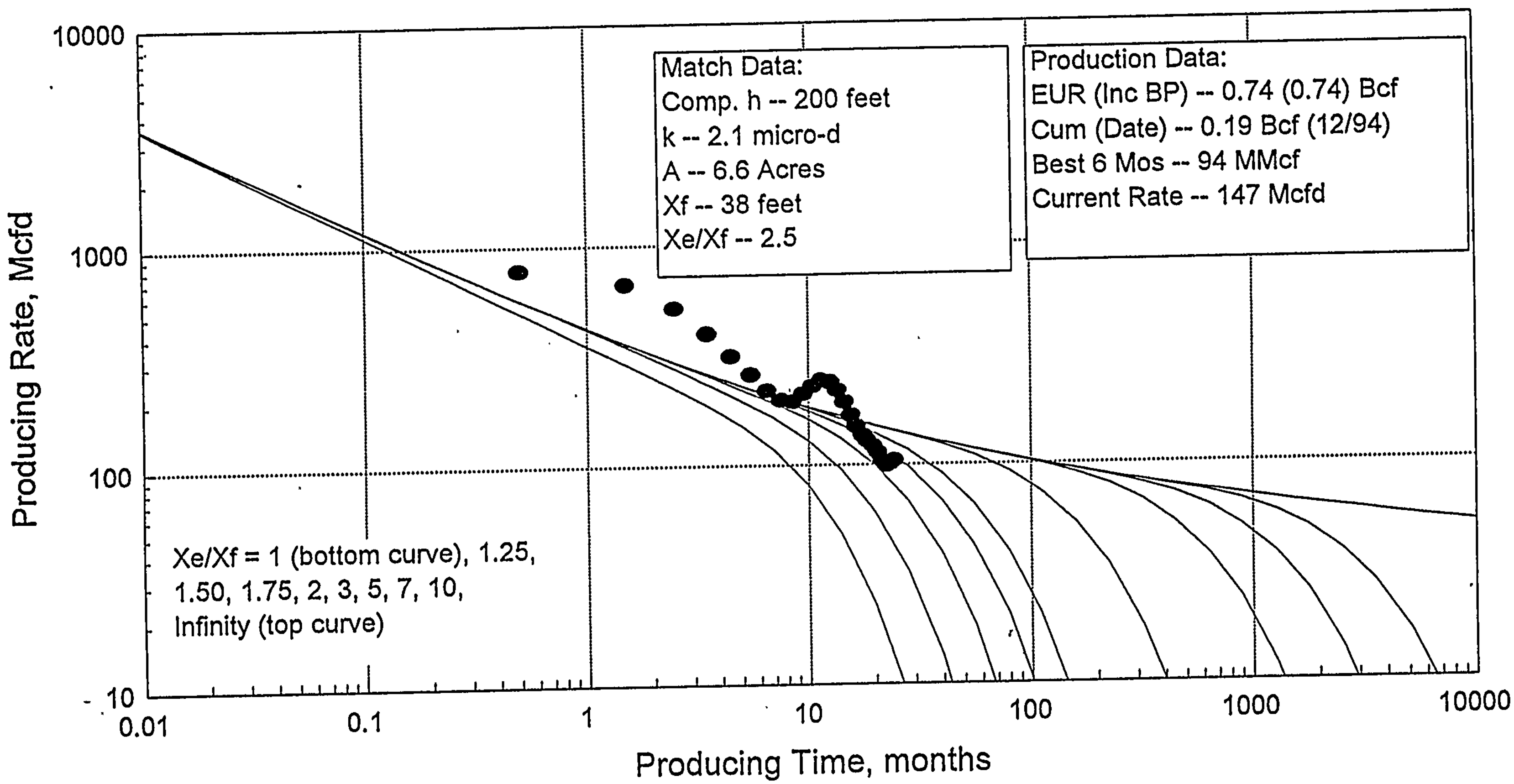
HMU Federal #30-16

(Ye/Xe=1)



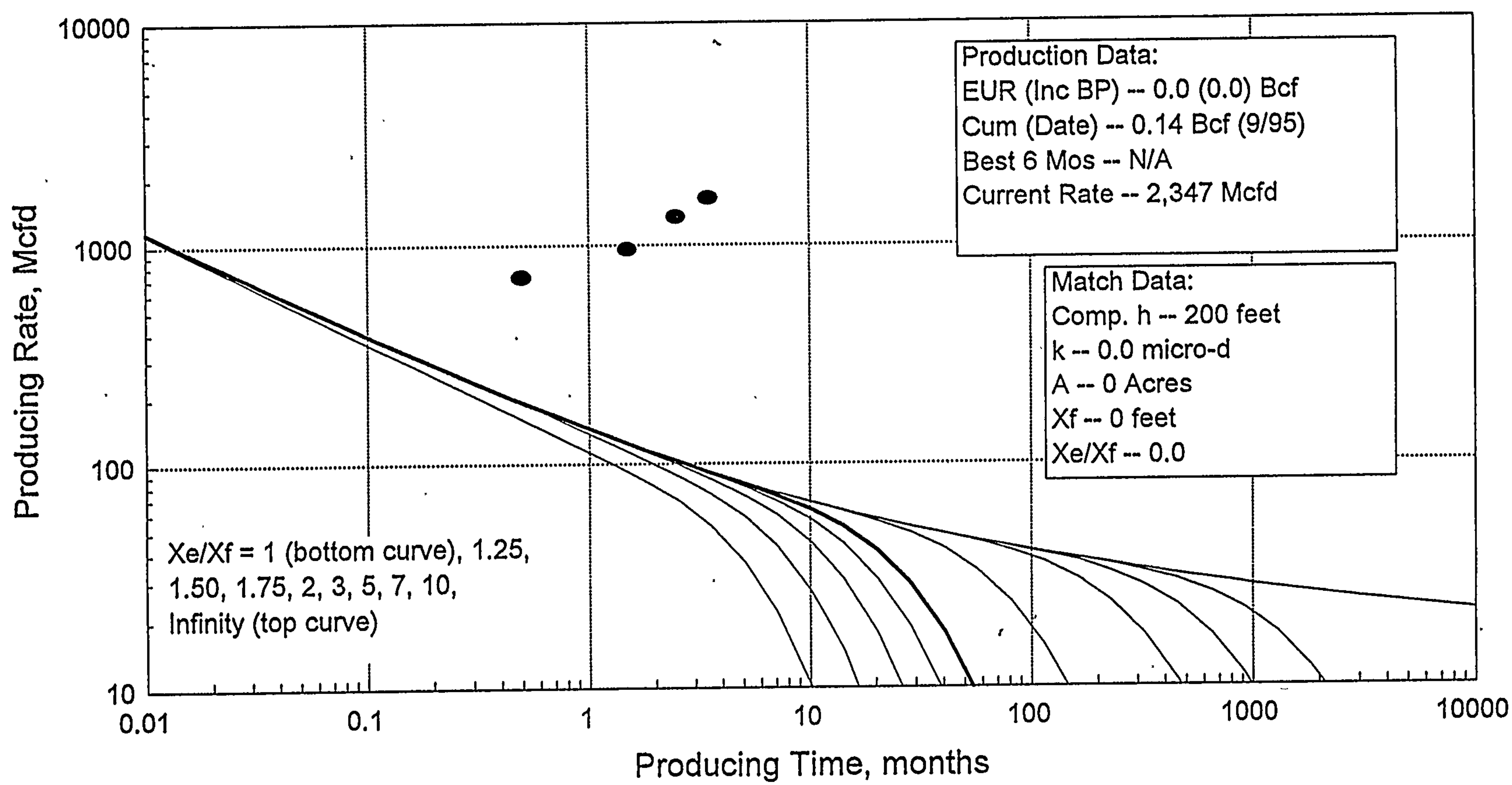
Kell #35-12

(Ye/Xe=1)



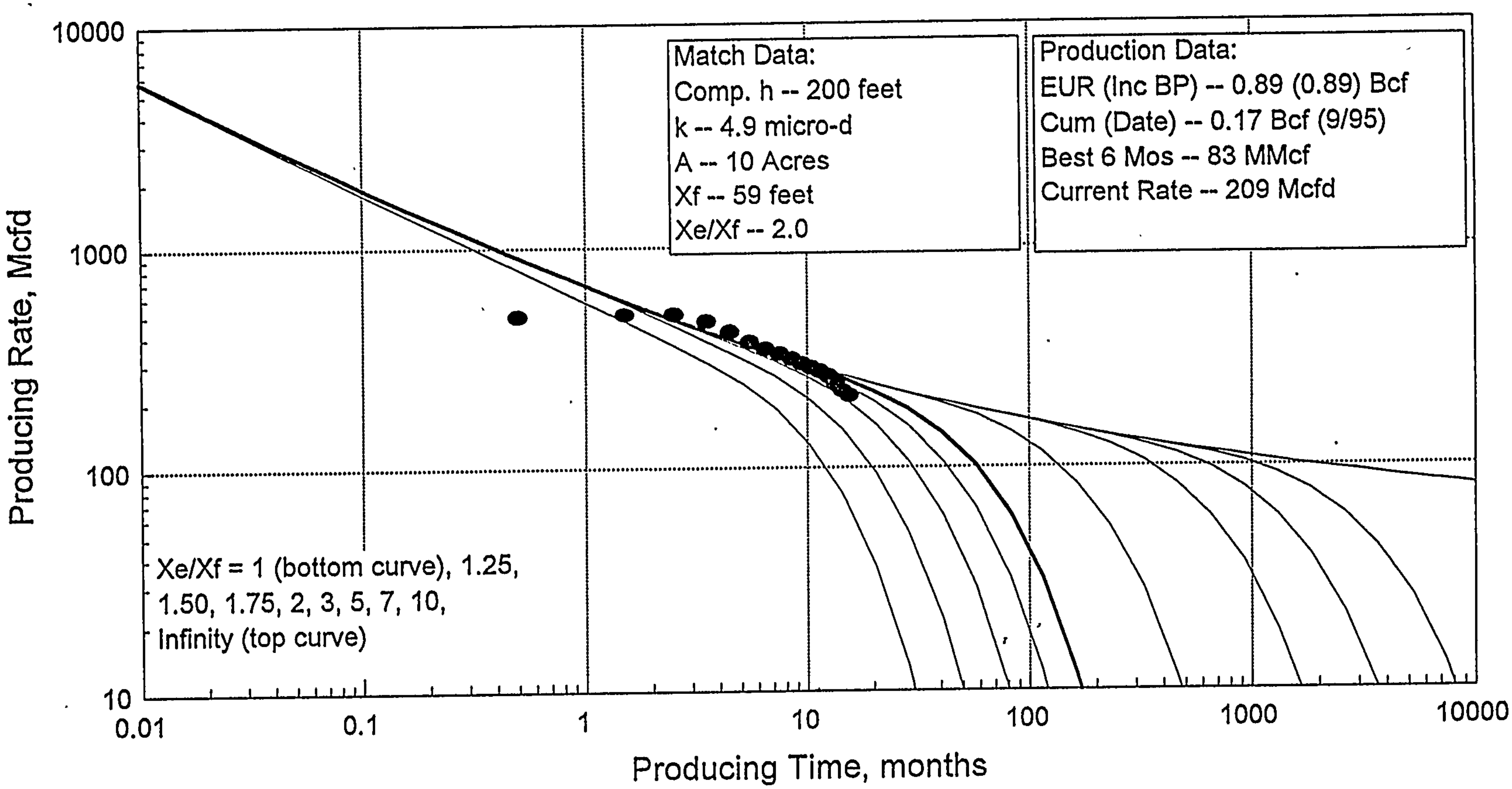
KRK #7-1

(Ye/Xe=1)


Production Data:
EUR (Inc BP) -- 0.0 (0.0) Bcf
Cum (Date) -- 0.14 Bcf (9/95)
Best 6 Mos -- N/A
Current Rate -- 2,347 Mcfd
Match Data:
Comp. h -- 200 feet
k -- 0.0 micro-d
A -- 0 Acres
Xf -- 0 feet
Xe/Xf -- 0.0
Xe/Xf = 1 (bottom curve), 1.25,
1.50, 1.75, 2, 3, 5, 7, 10,
Infinity (top curve)
Producing Rate, Mcfd
10000
1000
100
10
0.01
0.1
1
10
100
1000
10000
Producing Time, months

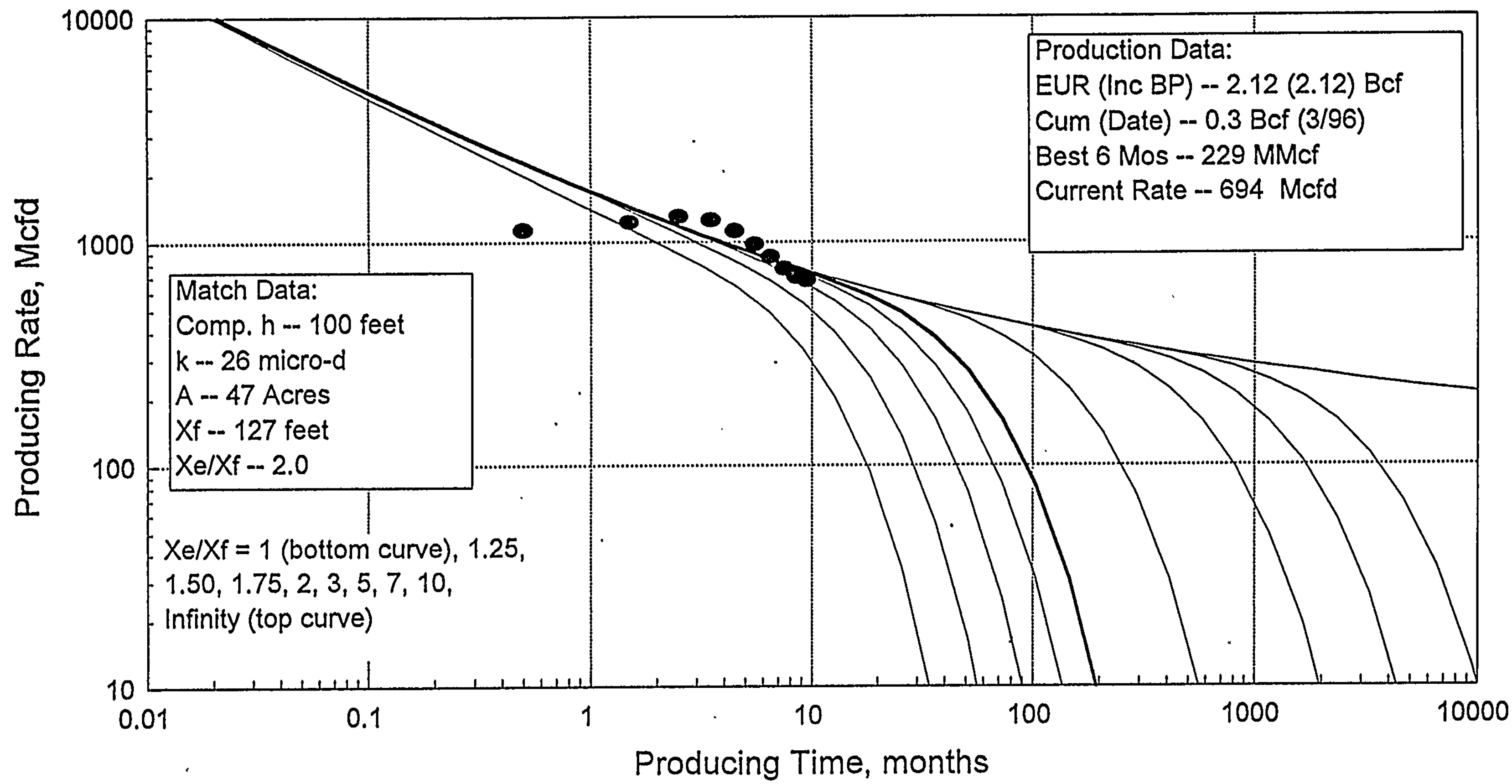
KRK #7-3

(Ye/Xe=1)


Match Data:
Comp. h -- 200 feet
k -- 4.9 micro-d
A -- 10 Acres
Xf -- 59 feet
Xe/Xf -- 2.0
Production Data:
EUR (Inc BP) -- 0.89 (0.89) Bcf
Cum (Date) -- 0.17 Bcf (9/95)
Best 6 Mos -- 83 MMcf
Current Rate -- 209 Mcfd
Xe/Xf = 1 (bottom curve), 1.25,
1.50, 1.75, 2, 3, 5, 7, 10,
Infinity (top curve)
Producing Rate, Mcfd
10000
1000
100
10
0.01
0.1
1
10
100
1000
10000
Producing Time, months

KRK #7-7

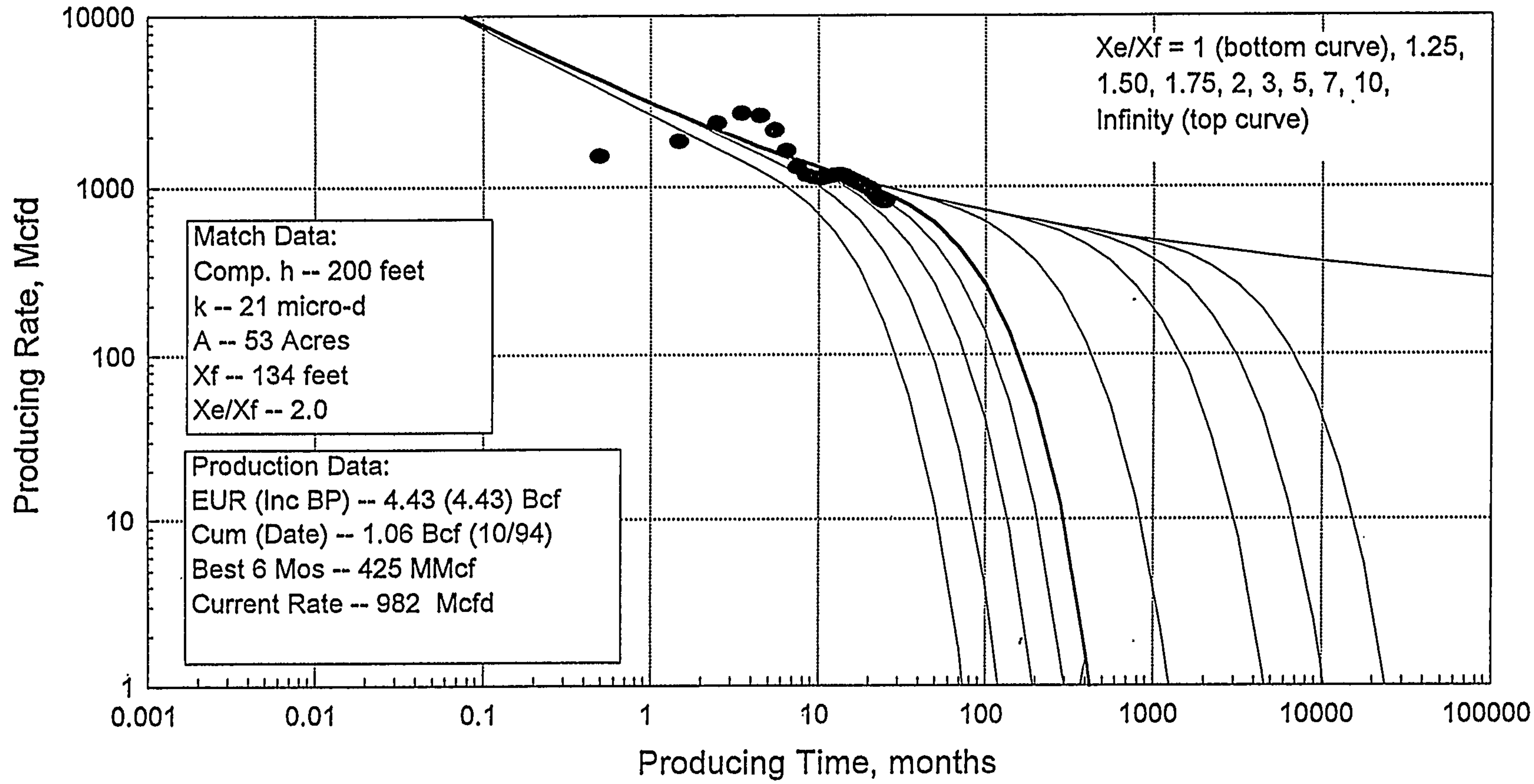
(Ye/Xe=1)



Production Data:
EUR (Inc BP) -- 2.12 (2.12) Bcf
Cum (Date) -- 0.3 Bcf (3/96)
Best 6 Mos -- 229 MMcf
Current Rate -- 694 Mcfd
Match Data:
Comp. h -- 100 feet
k -- 26 micro-d
A -- 47 Acres
Xf -- 127 feet
Xe/Xf -- 2.0
Xe/Xf = 1 (bottom curve), 1.25,
1.50, 1.75, 2, 3, 5, 7, 10,
Infinity (top curve)
Producing Rate, Mcfd
10000
1000
100
10
0.01
0.1
1
10
100
1000
10000
Producing Time, months

KRK #7-8

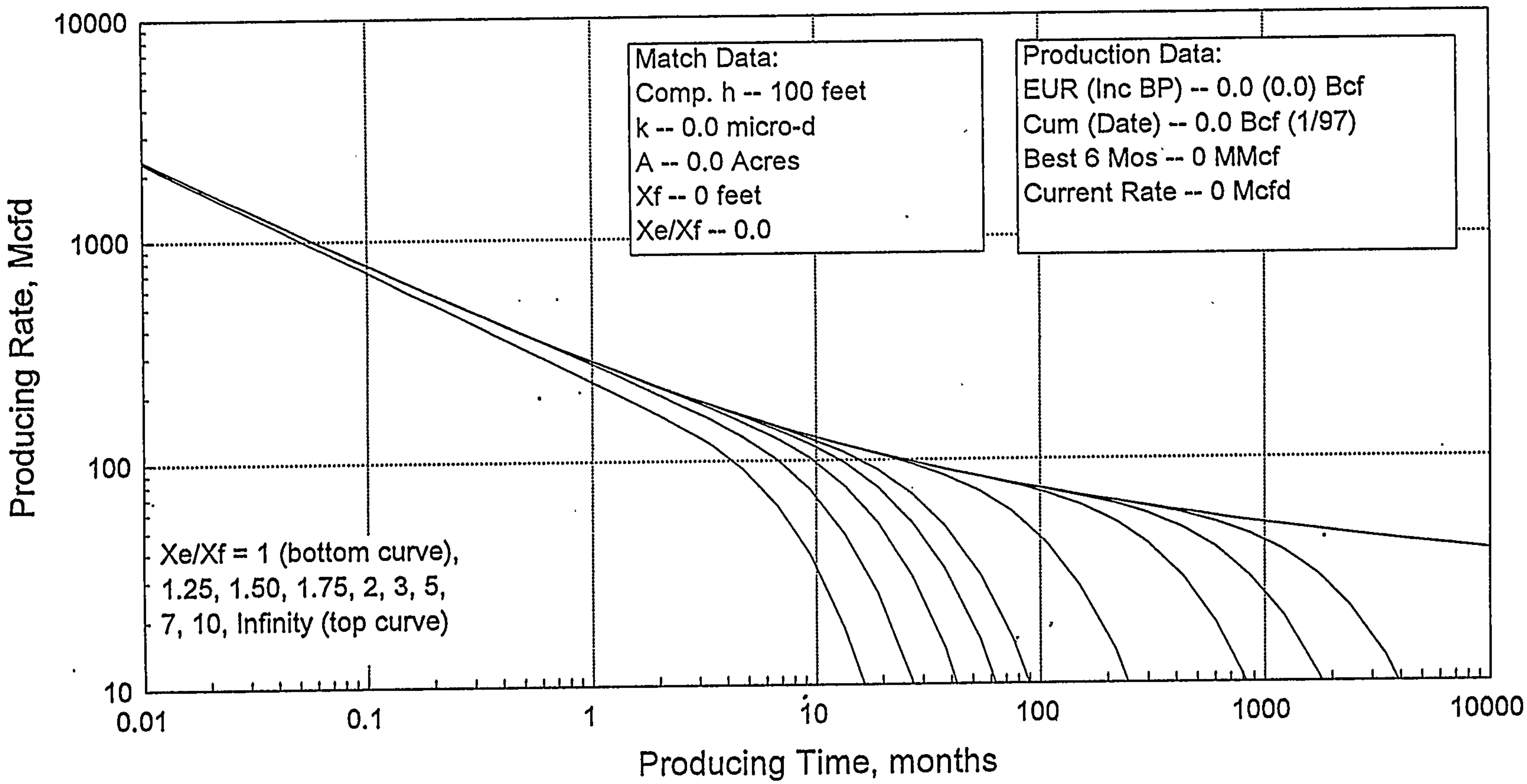
(Ye/Xe=1)



Xe/Xf = 1 (bottom curve), 1.25, 1.50, 1.75, 2, 3, 5, 7, 10, Infinity (top curve)
Match Data:
Comp. h -- 200 feet
k -- 21 micro-d
A -- 53 Acres
Xf -- 134 feet
Xe/Xf -- 2.0
Production Data:
EUR (Inc BP) -- 4.43 (4.43) Bcf
Cum (Date) -- 1.06 Bcf (10/94)
Best 6 Mos -- 425 MMcf
Current Rate -- 982 Mcfd
Producing Rate, Mcfd
10000
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
10000
100000
Producing Time, months

KRK #7-9

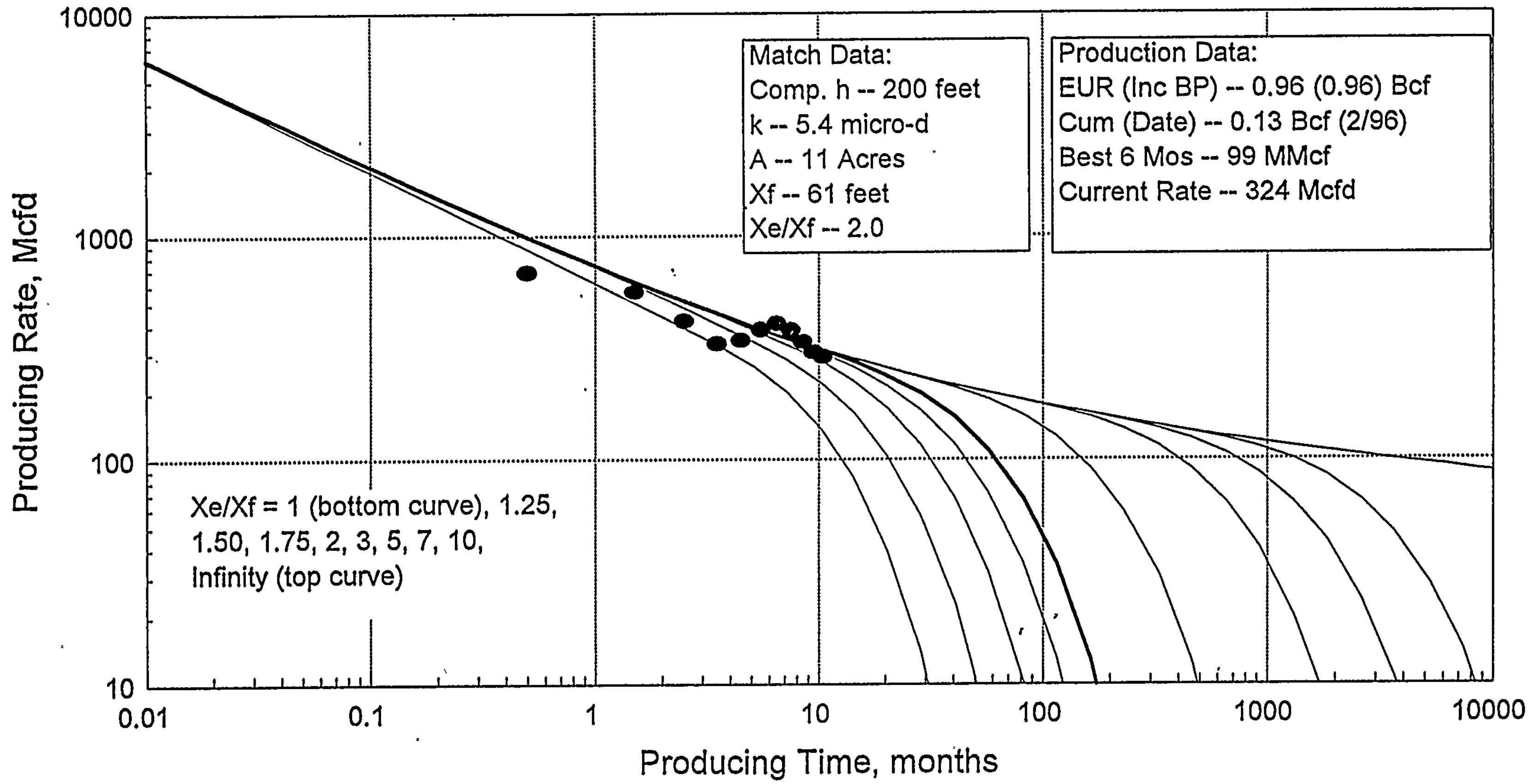
(Ye/Xe=1)



Match Data:
Comp. h -- 100 feet
k -- 0.0 micro-d
A -- 0.0 Acres
Xf -- 0 feet
Xe/Xf -- 0.0
Production Data:
EUR (Inc BP) -- 0.0 (0.0) Bcf
Cum (Date) -- 0.0 Bcf (1/97)
Best 6 Mos -- 0 MMcf
Current Rate -- 0 Mcfd
Xe/Xf = 1 (bottom curve),
1.25, 1.50, 1.75, 2, 3, 5,
7, 10, Infinity (top curve)
10000
1000
100
10
0.01
0.1
1
10
100
1000
10000
Producing Rate, Mcfd
Producing Time, months

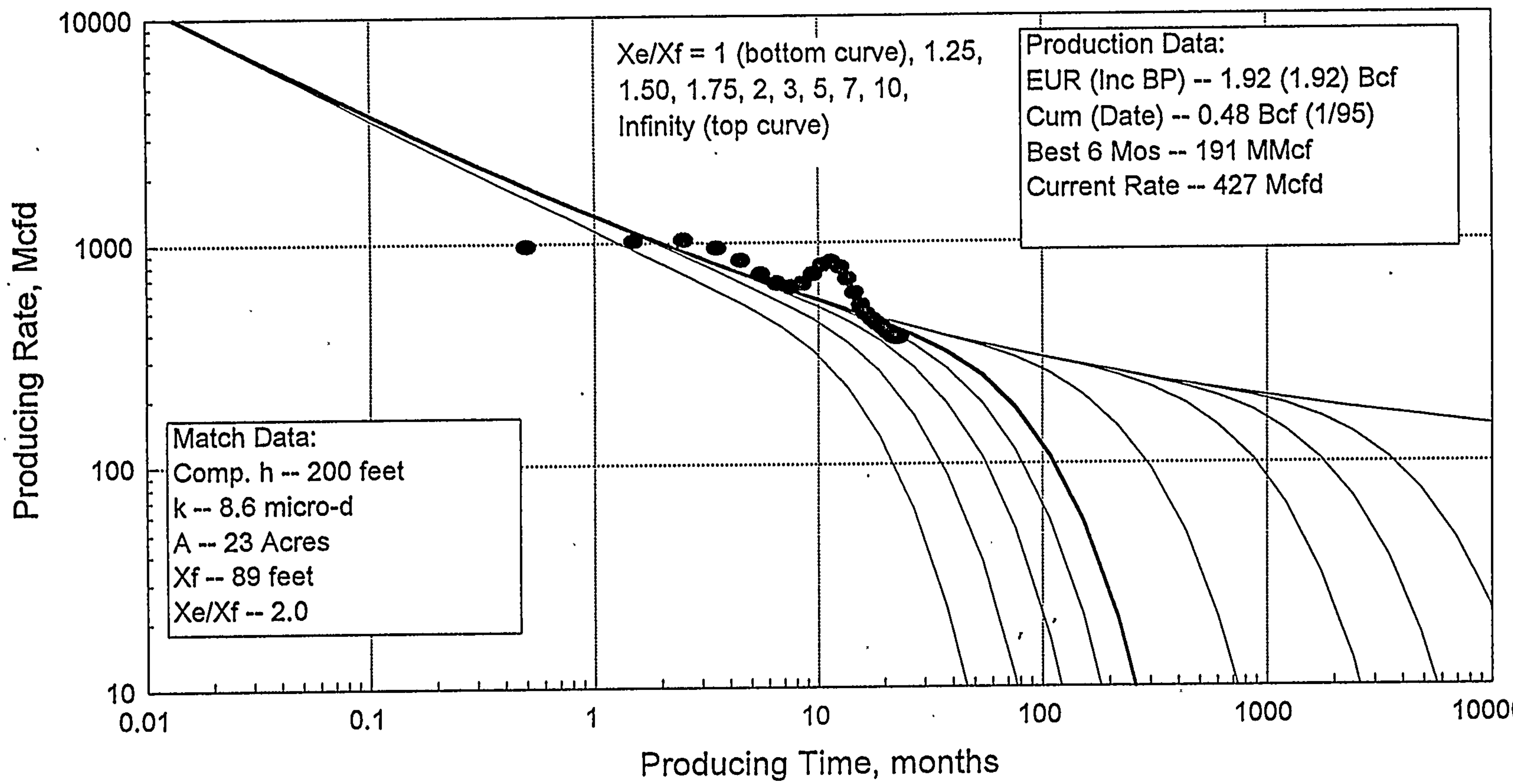
KRK #7-10

(Ye/Xe=1)



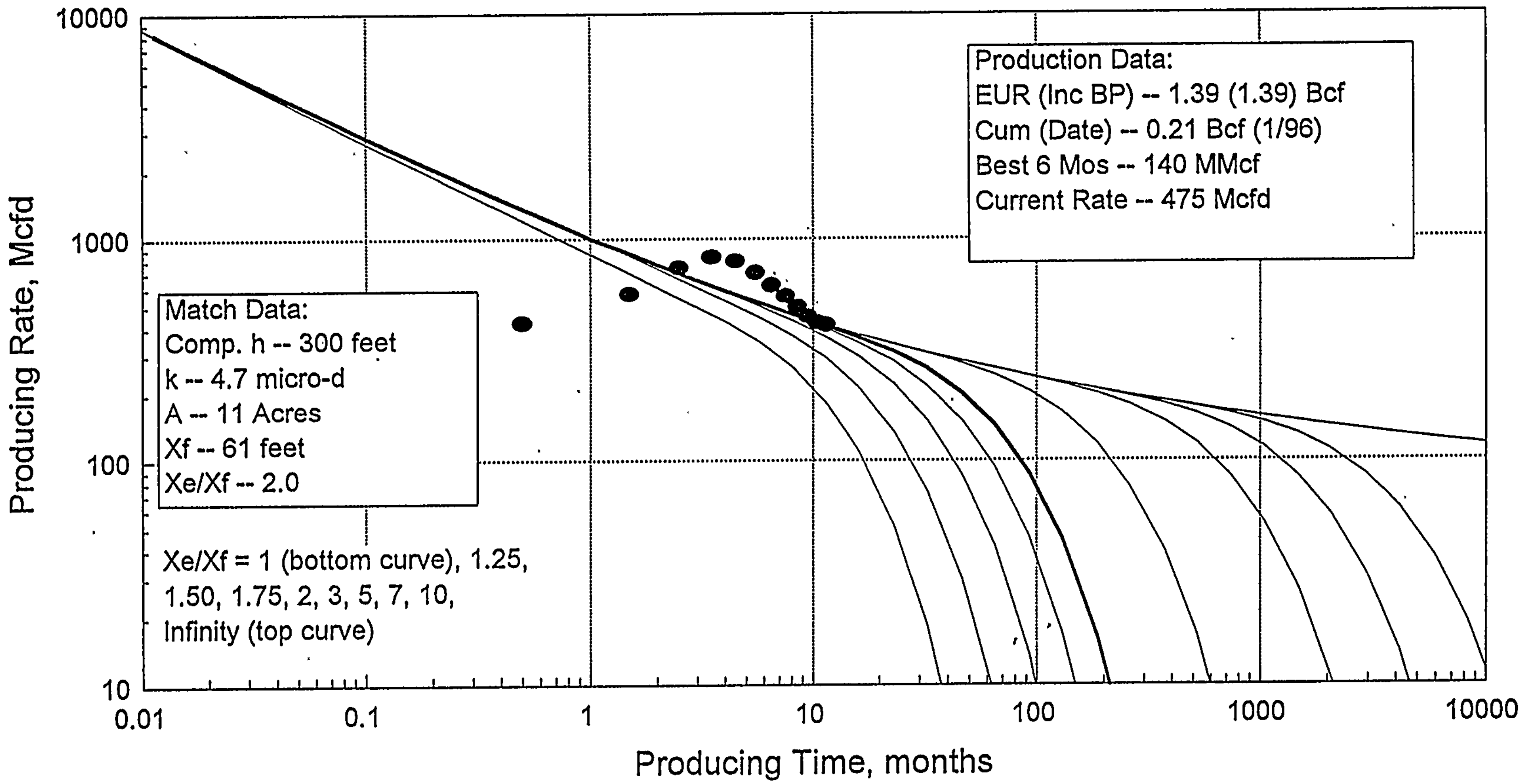
KRK #7-11

(Ye/Xe=1)



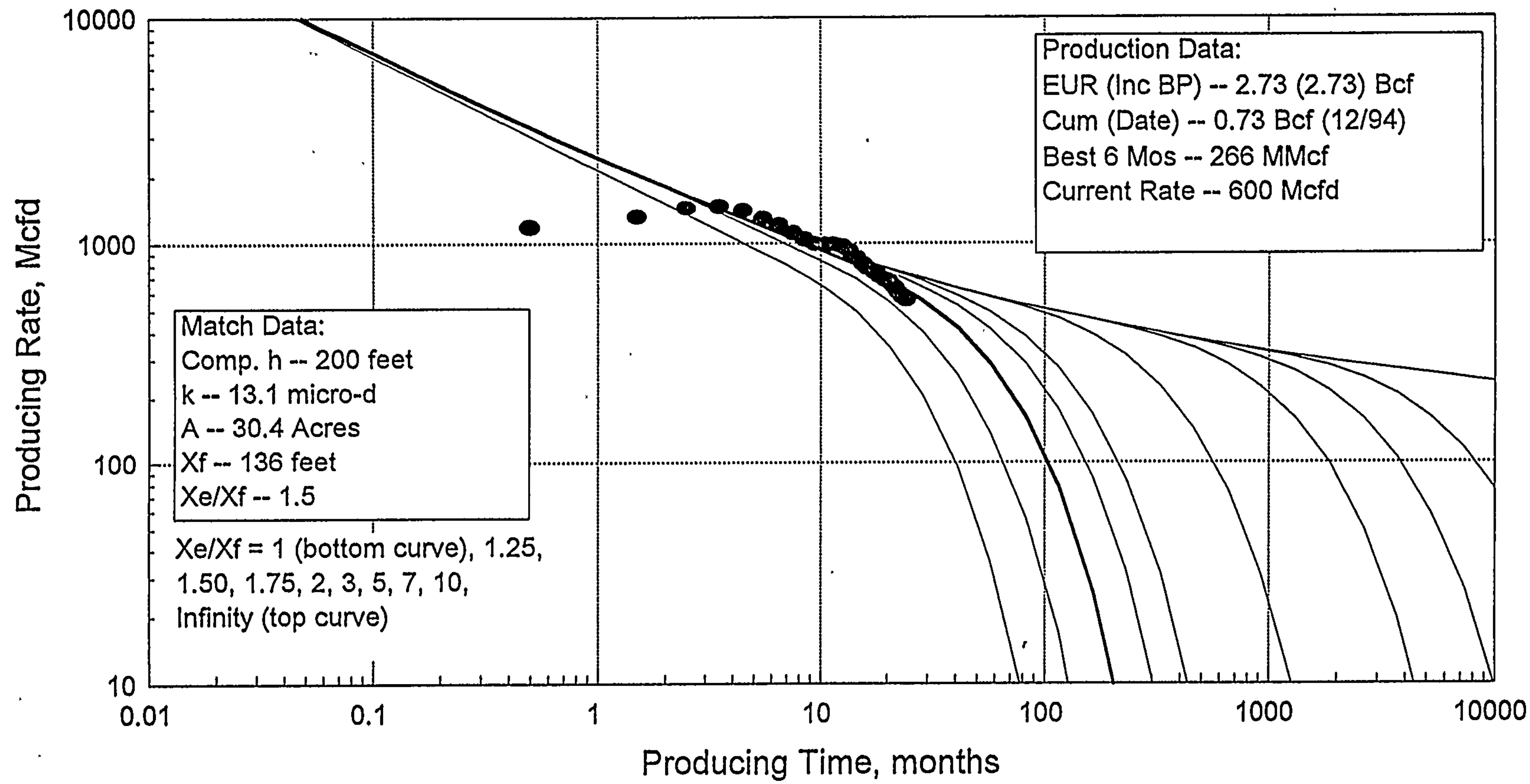
KRK #7-15

(Ye/Xe=1)



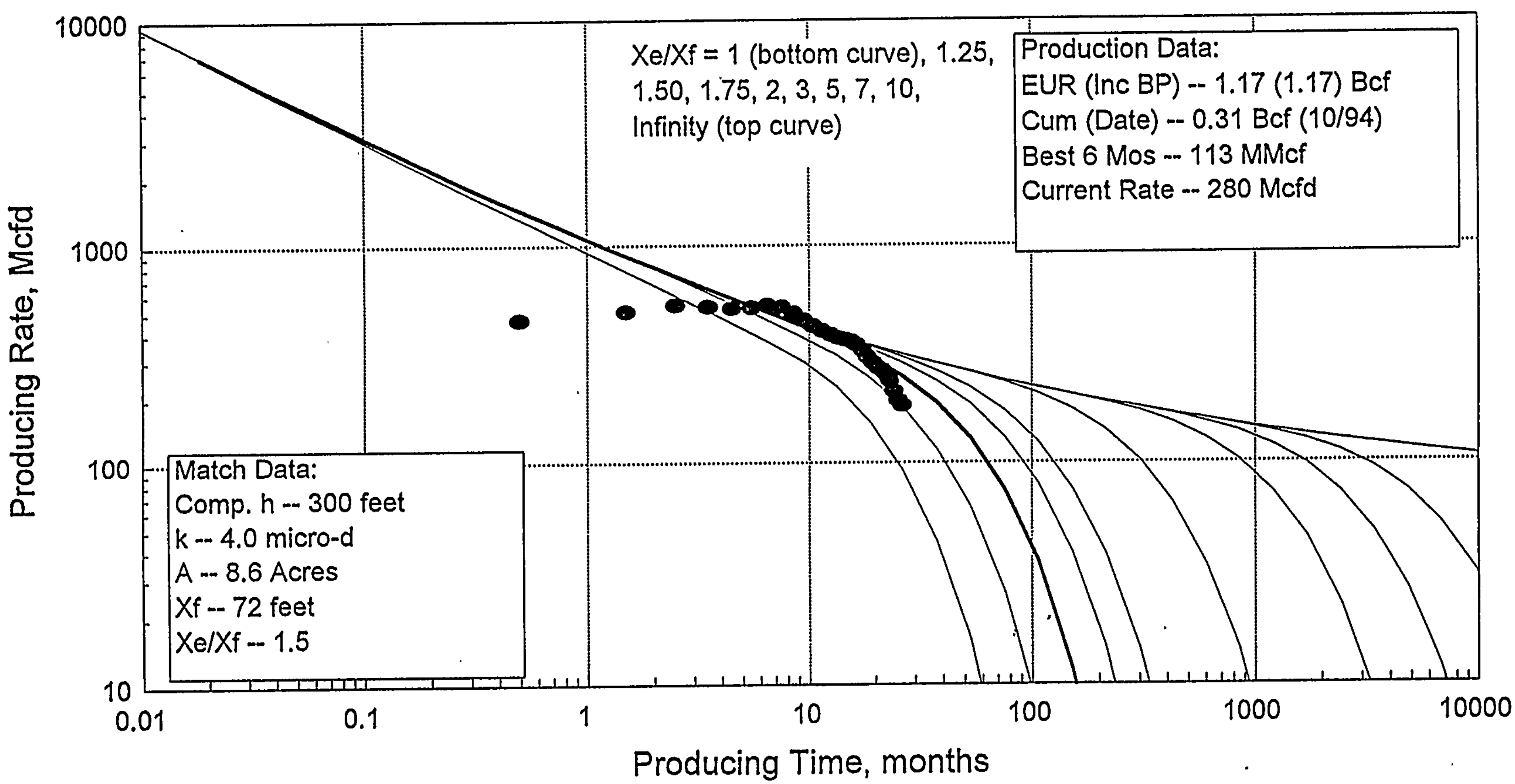
KRK #7-16

(Ye/Xe=1)



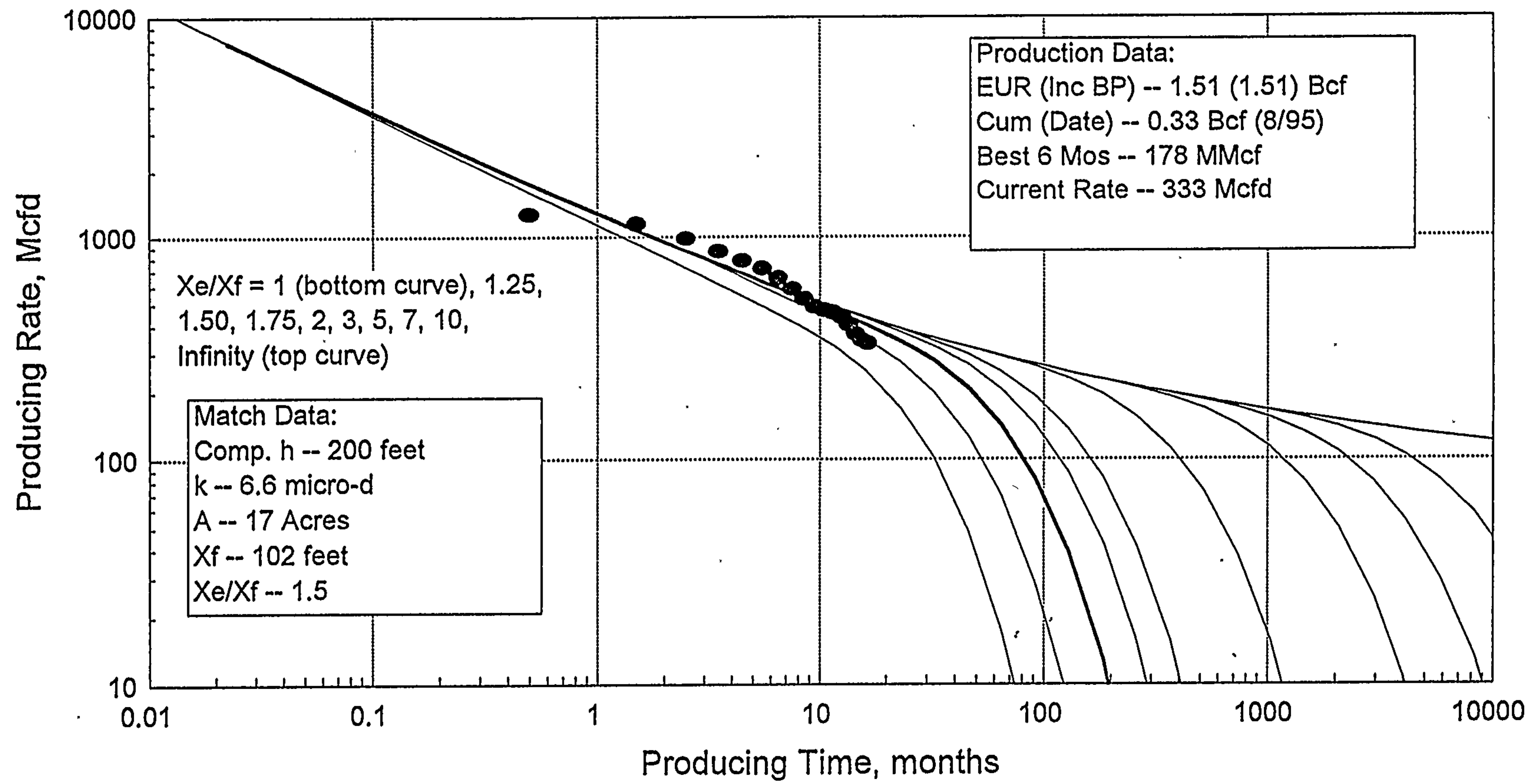
Mam Creek Ranch #29-4

(Ye/Xe=1)



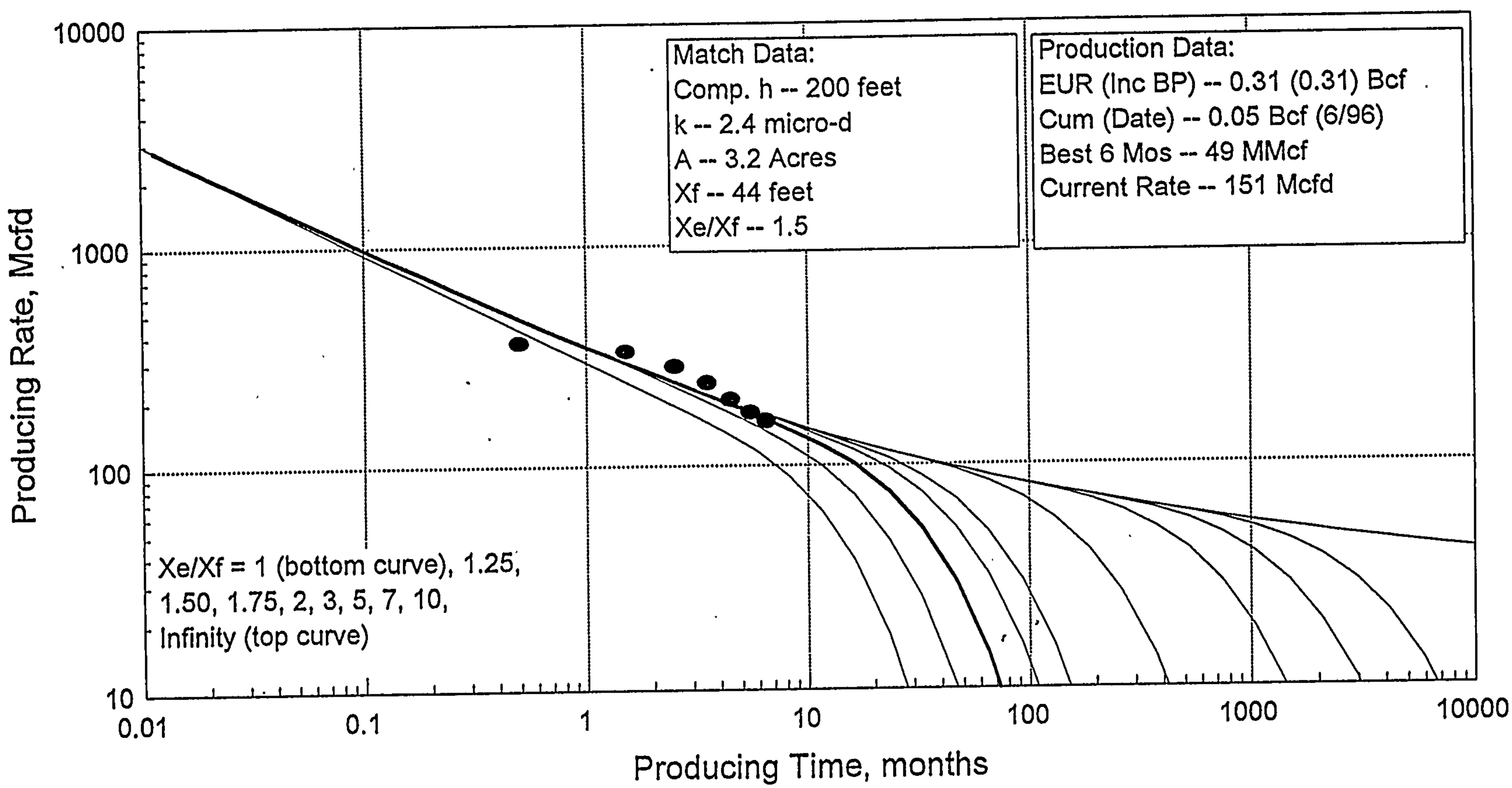
Parker Ranch #10-9

(Ye/Xe=1)



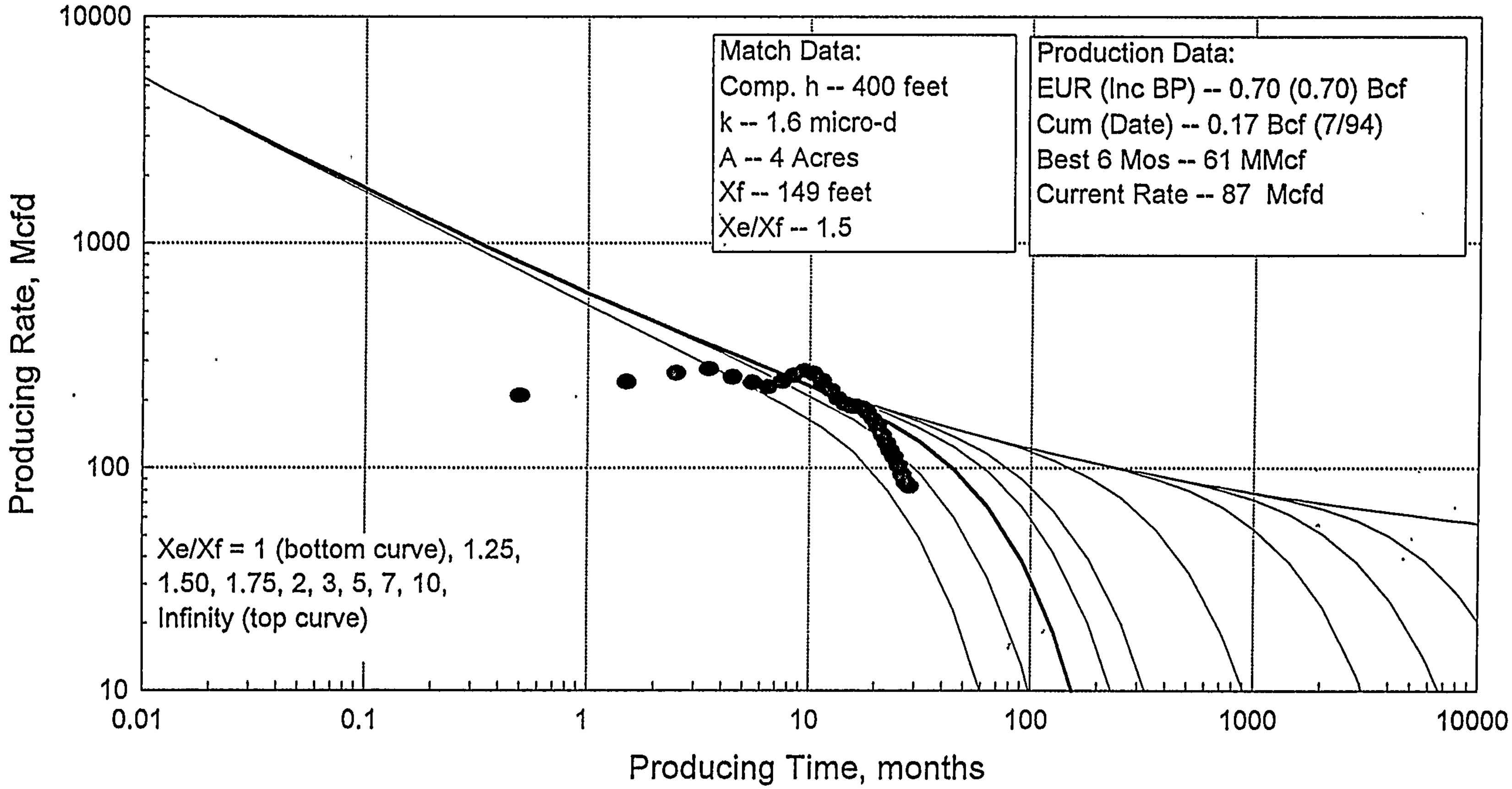
Parker Ranch #11-14

(Ye/Xe=1)



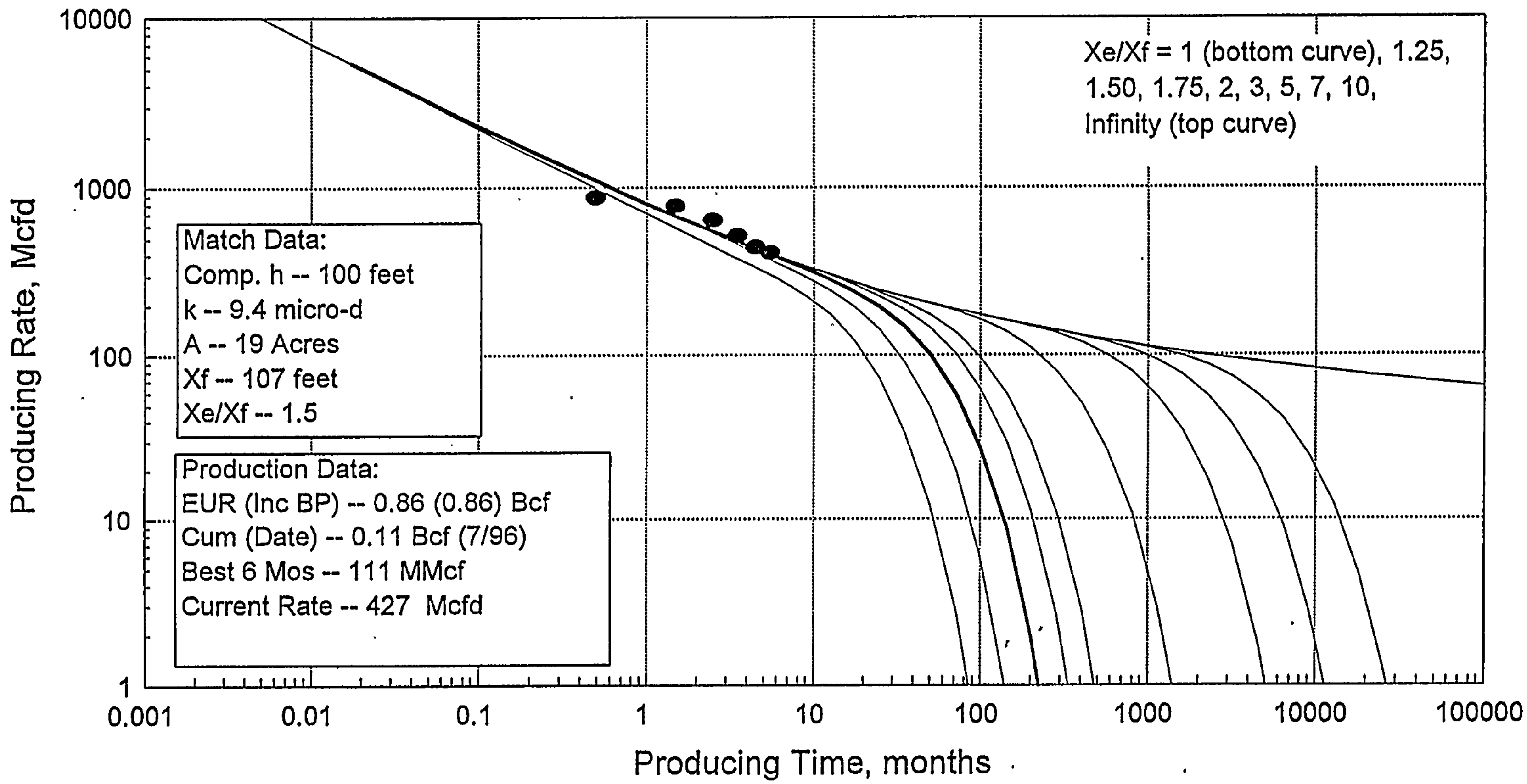
Parker Ranch #14-10

(Ye/Xe=1)



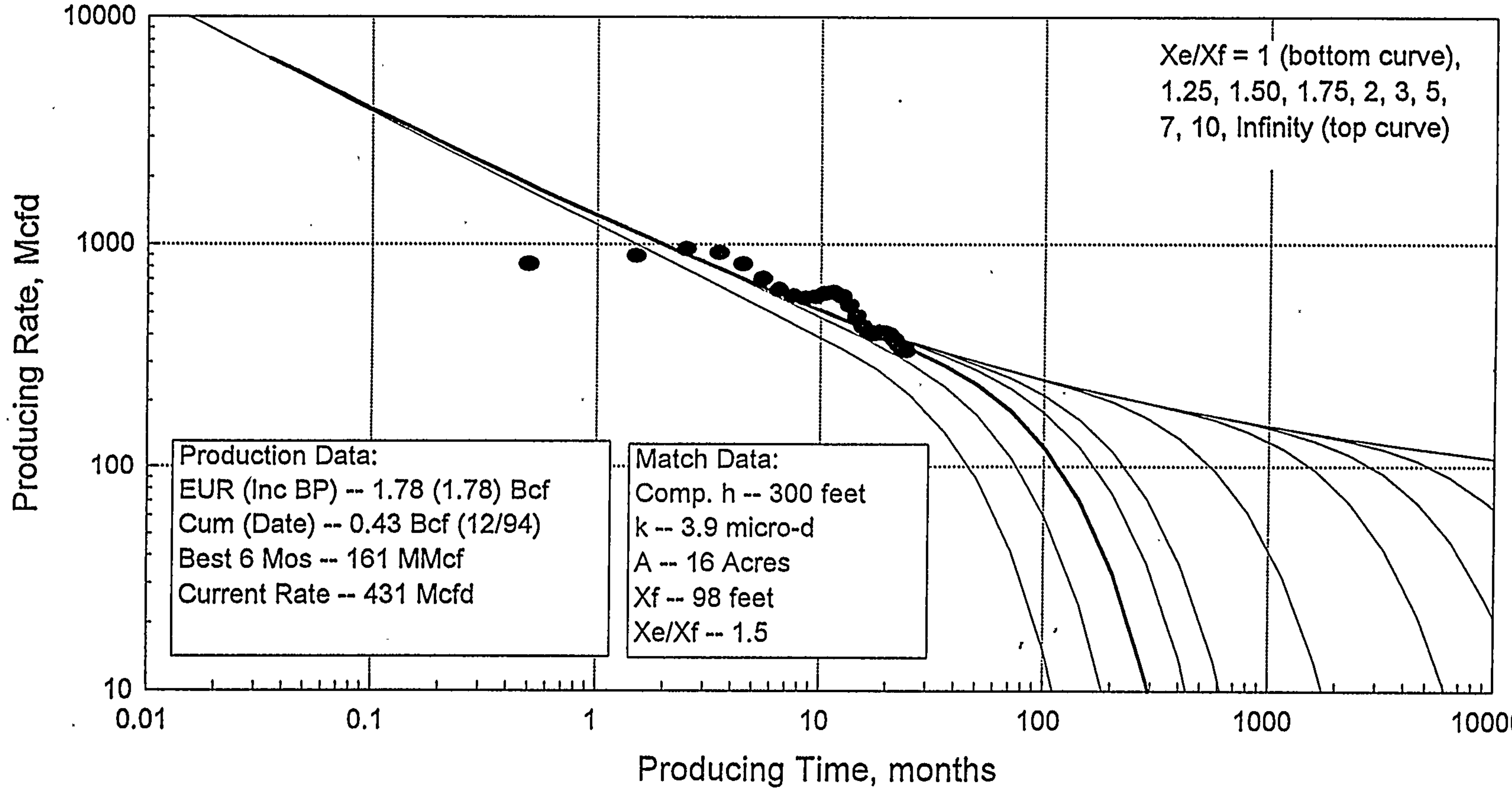
Parker Ranch #15-4

(Ye/Xe=1)



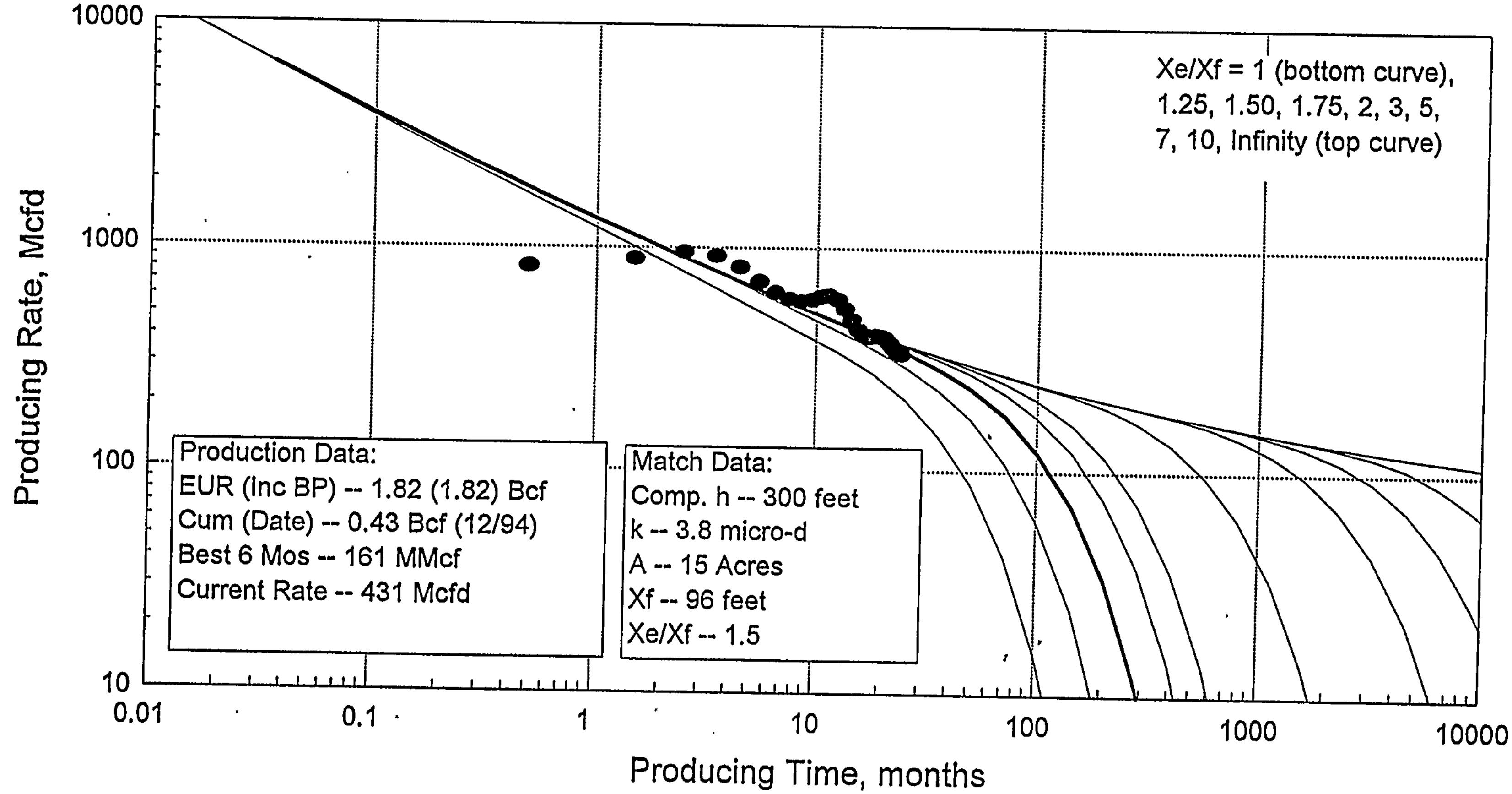
Parker Ranch #15-8

(Ye/Xe=1)



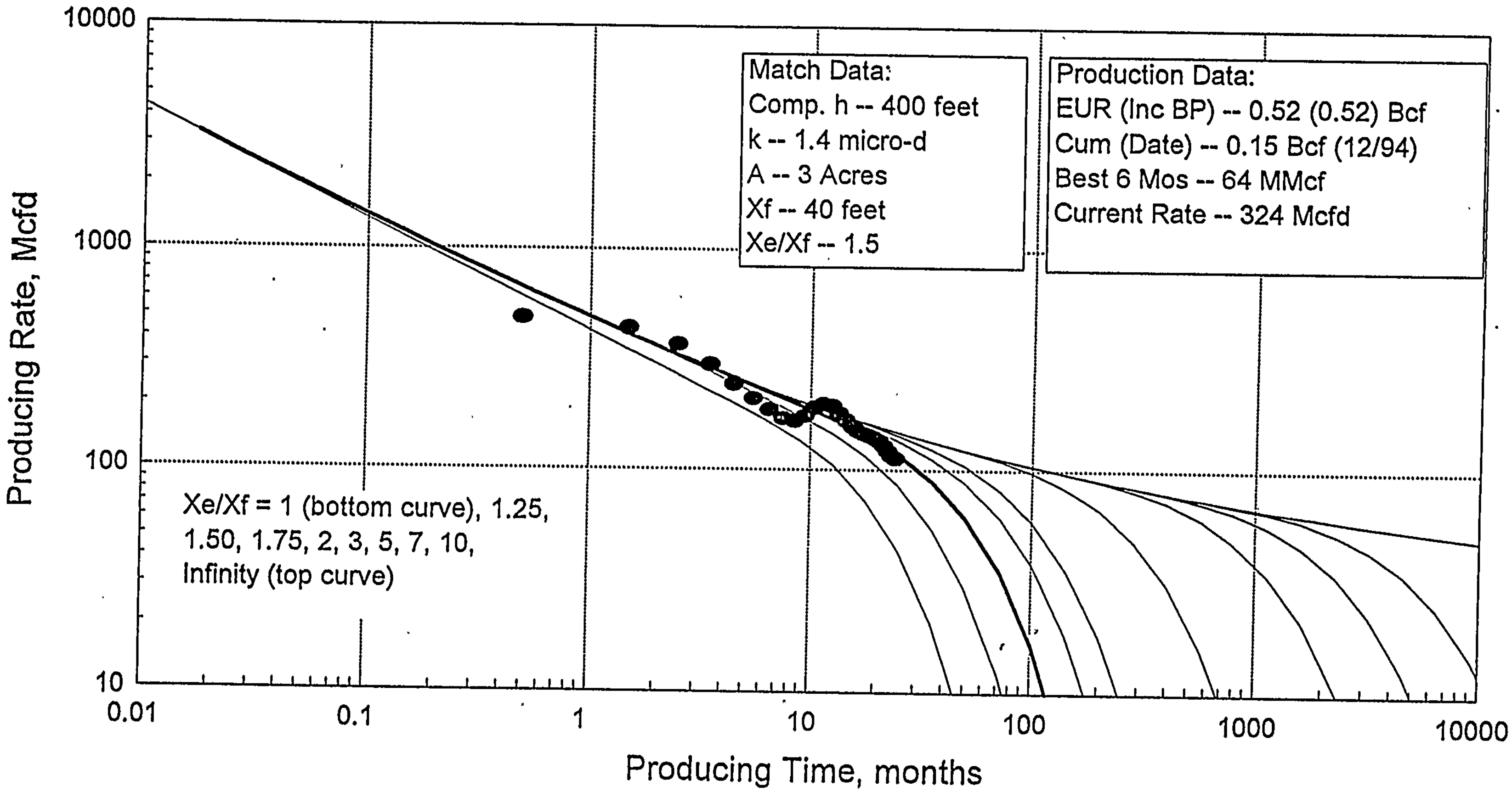
Parker Ranch #15-8

(Ye/Xe=1)



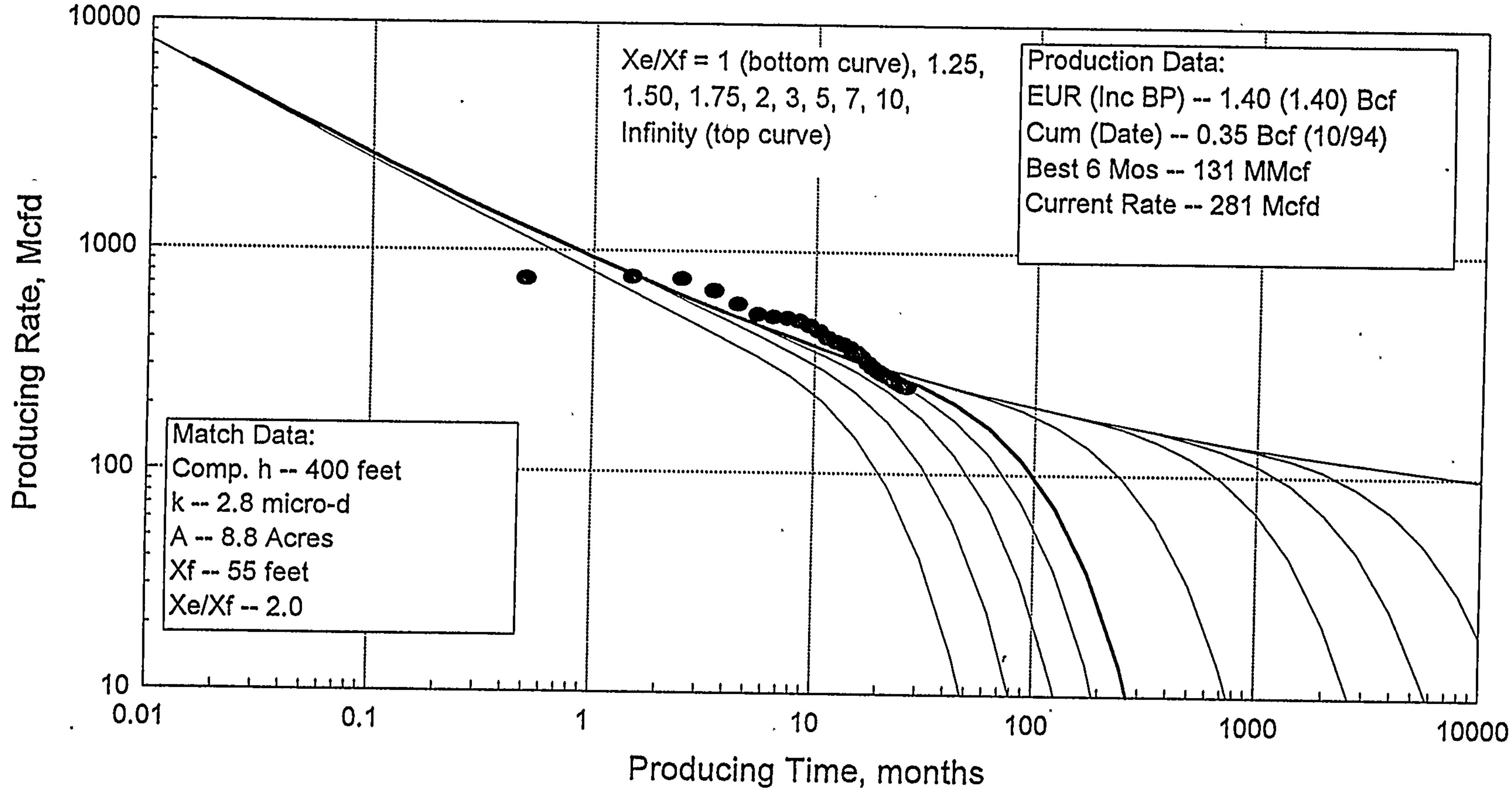
Parker Ranch #22-7

(Ye/Xe=1)



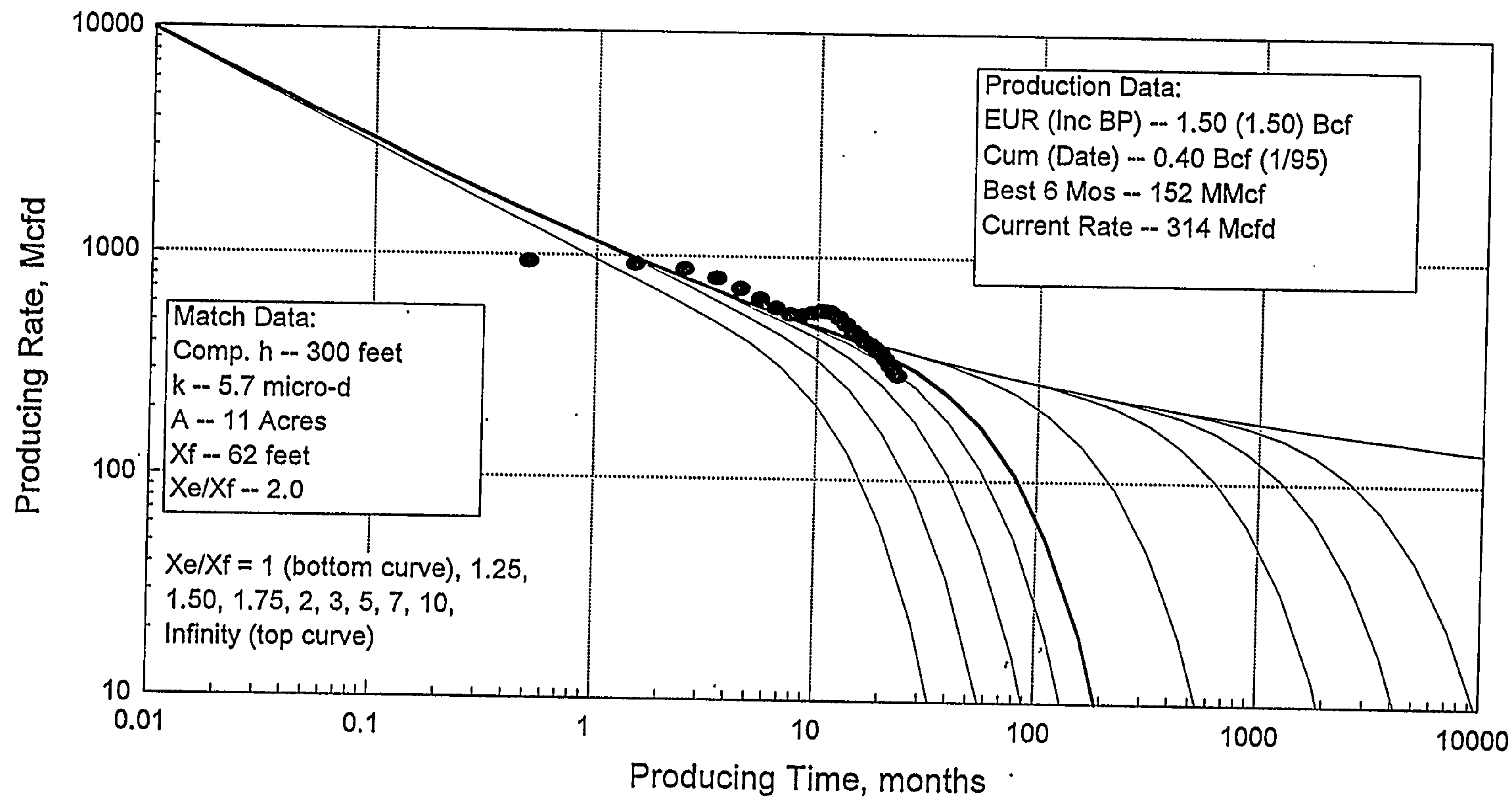
Pitman #13-4

(Ye/Xe=1)



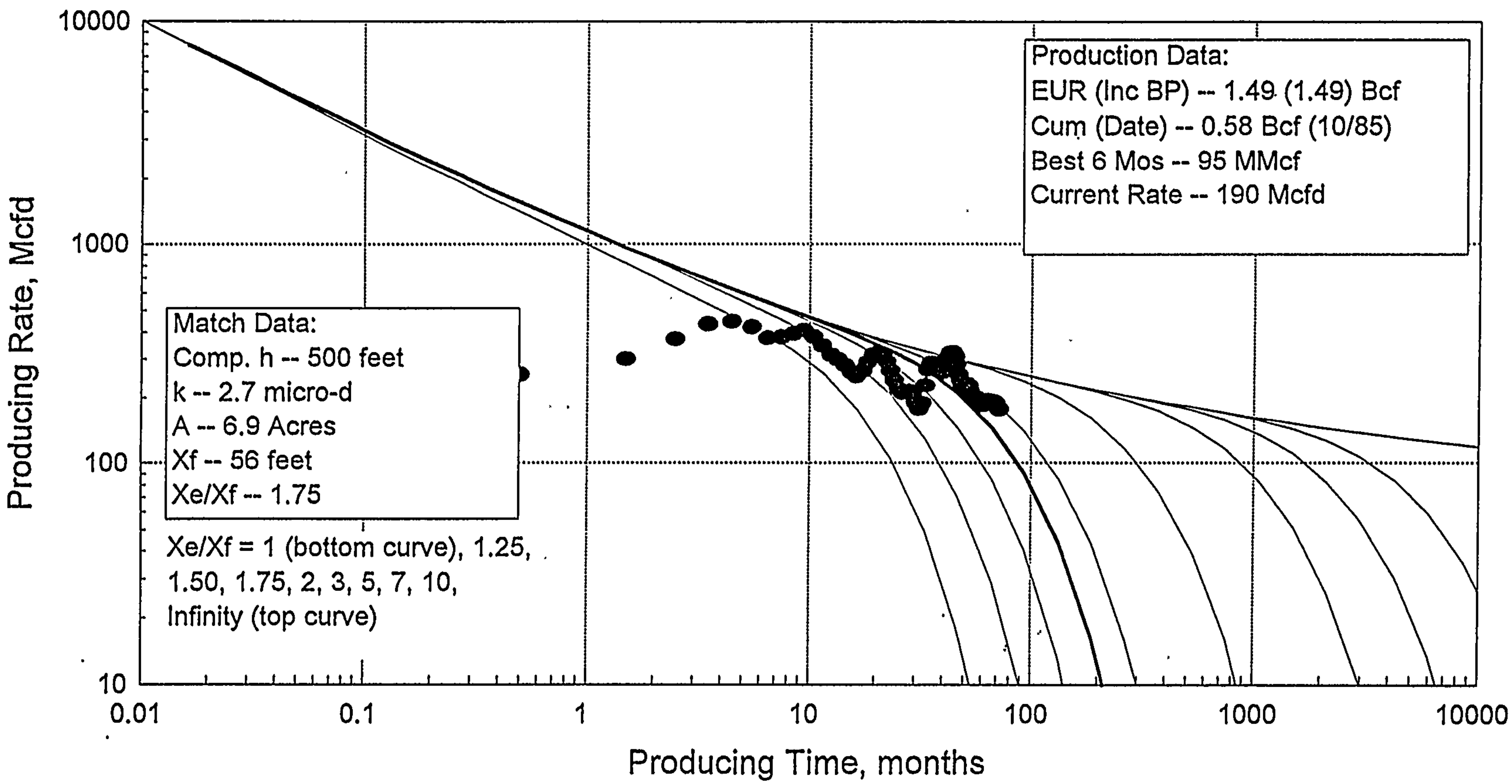
Pitman #18-2

(Ye/Xe=1)



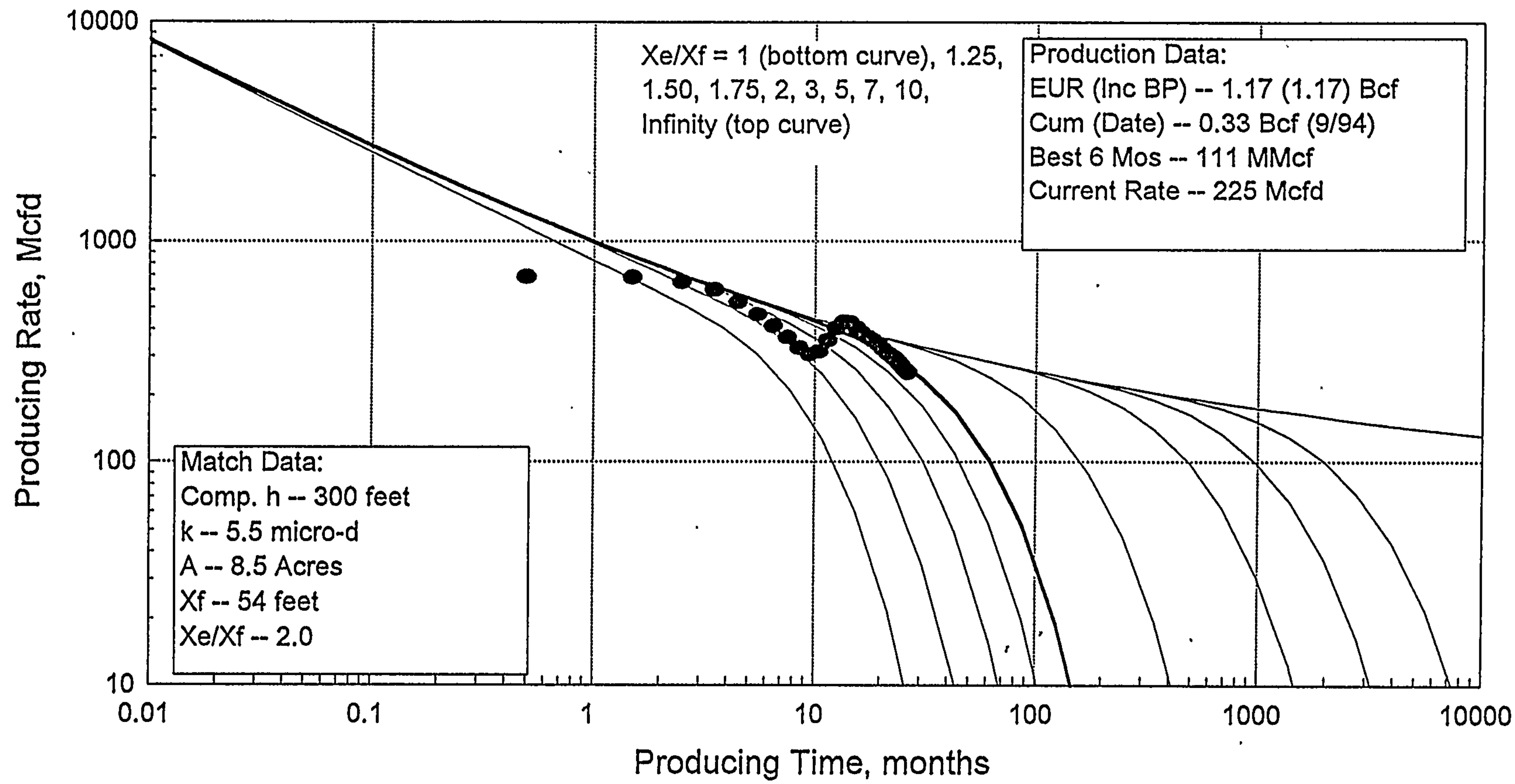
R. H. Ranch #1

(Ye/Xe=1)



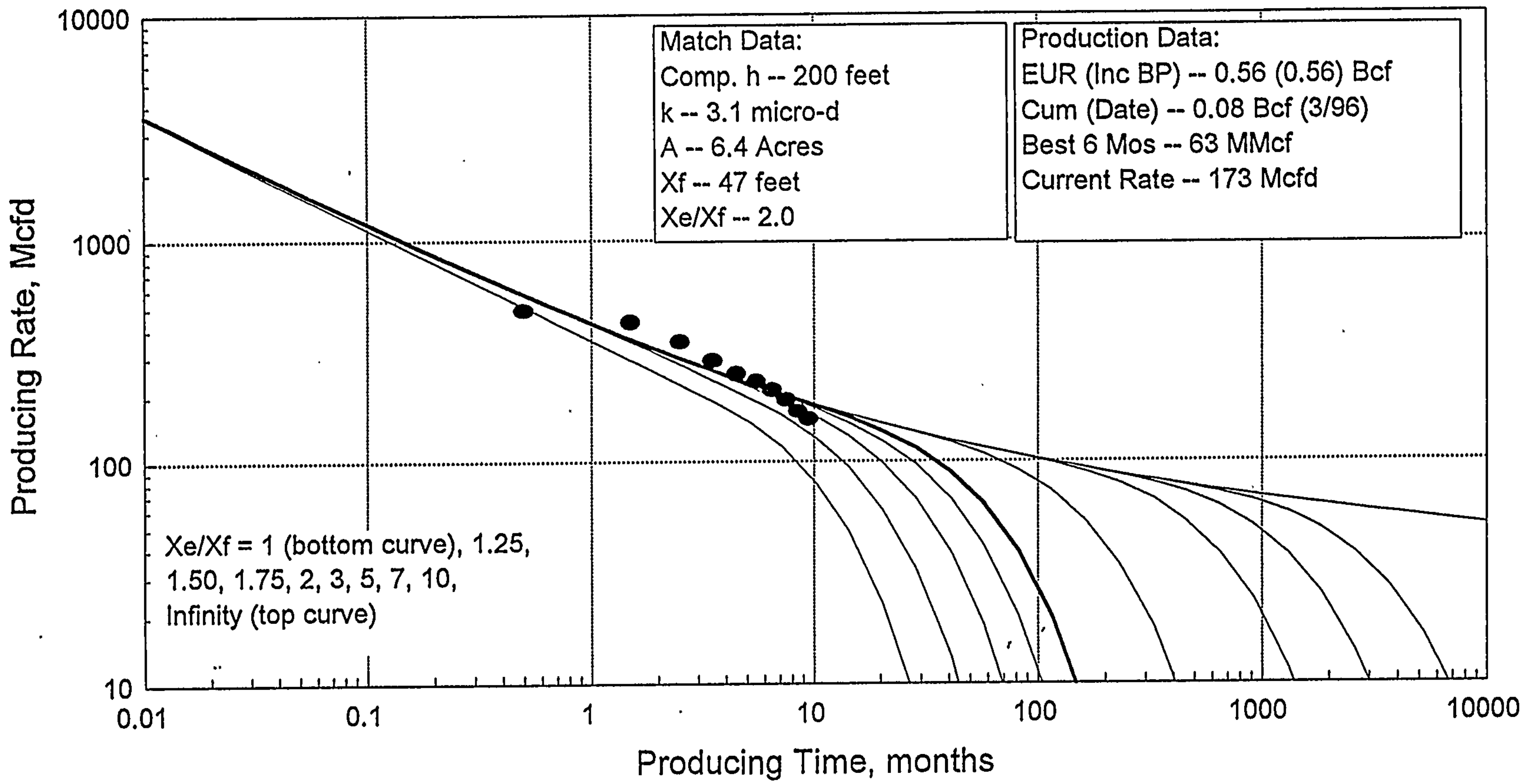
Shaeffer #12-6

(Ye/Xe=1)



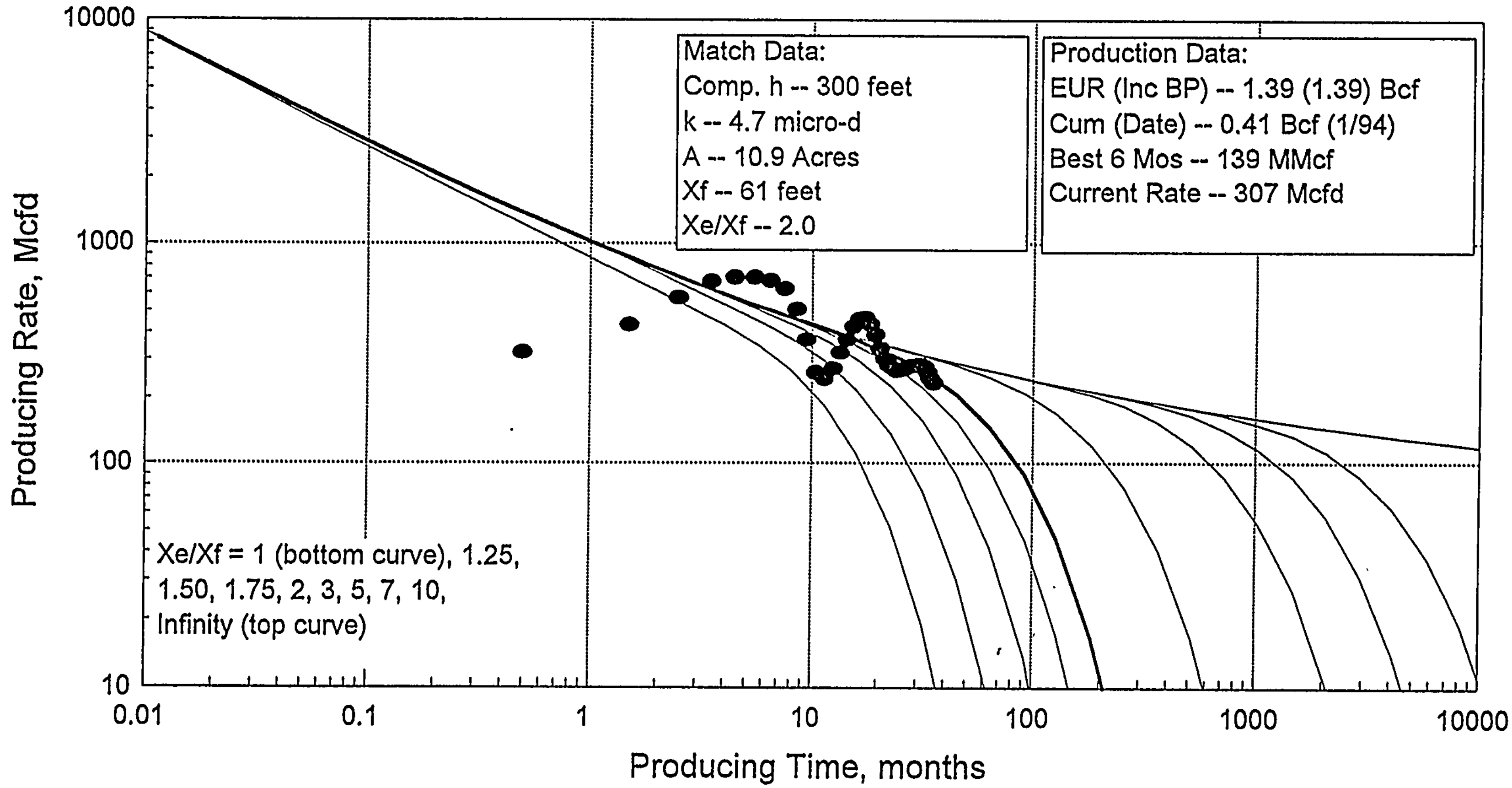
Shaeffer #12-8

(Ye/Xe=1)



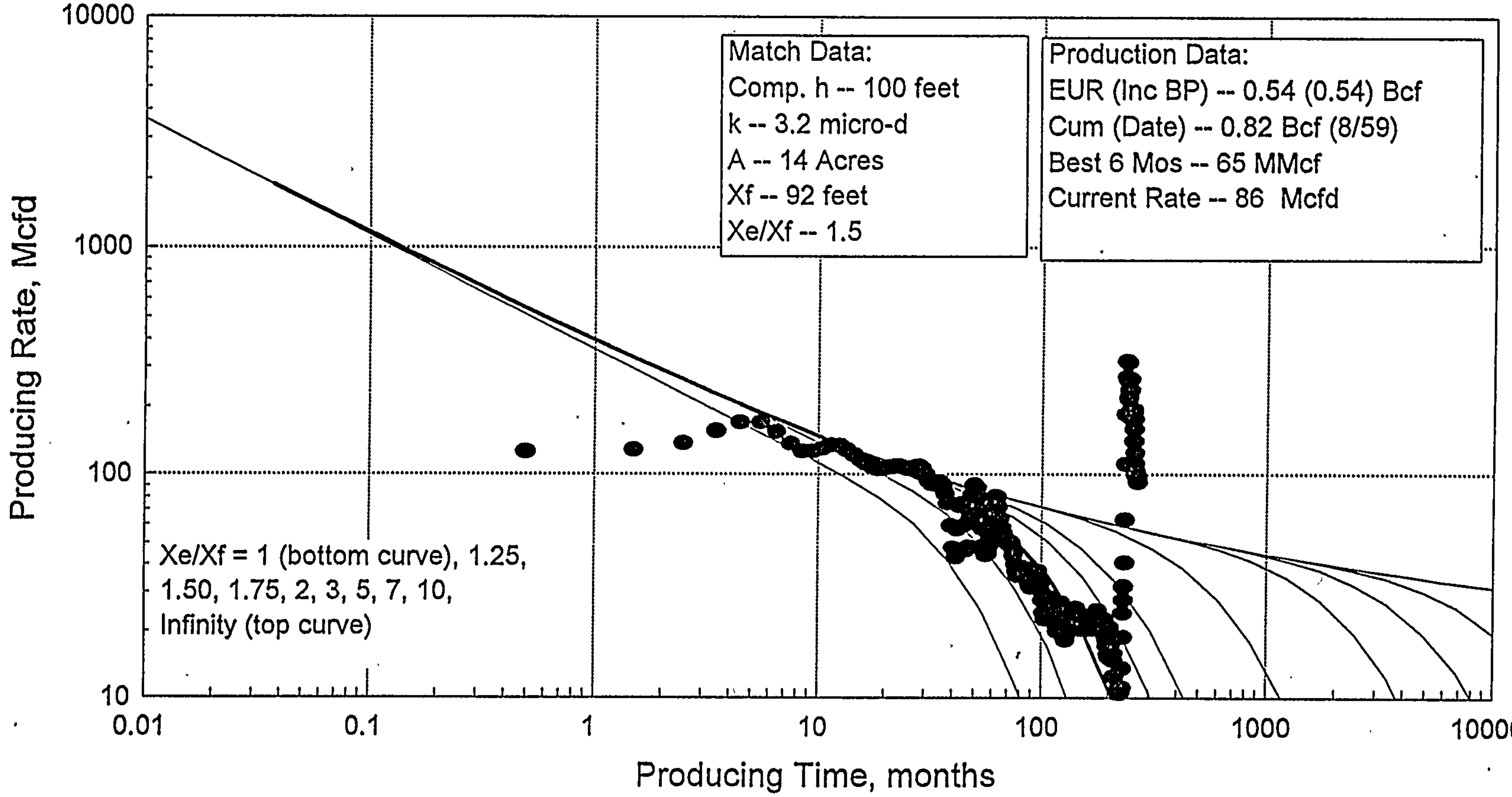
Shaeffer #18-5

(Ye/Xe=1)



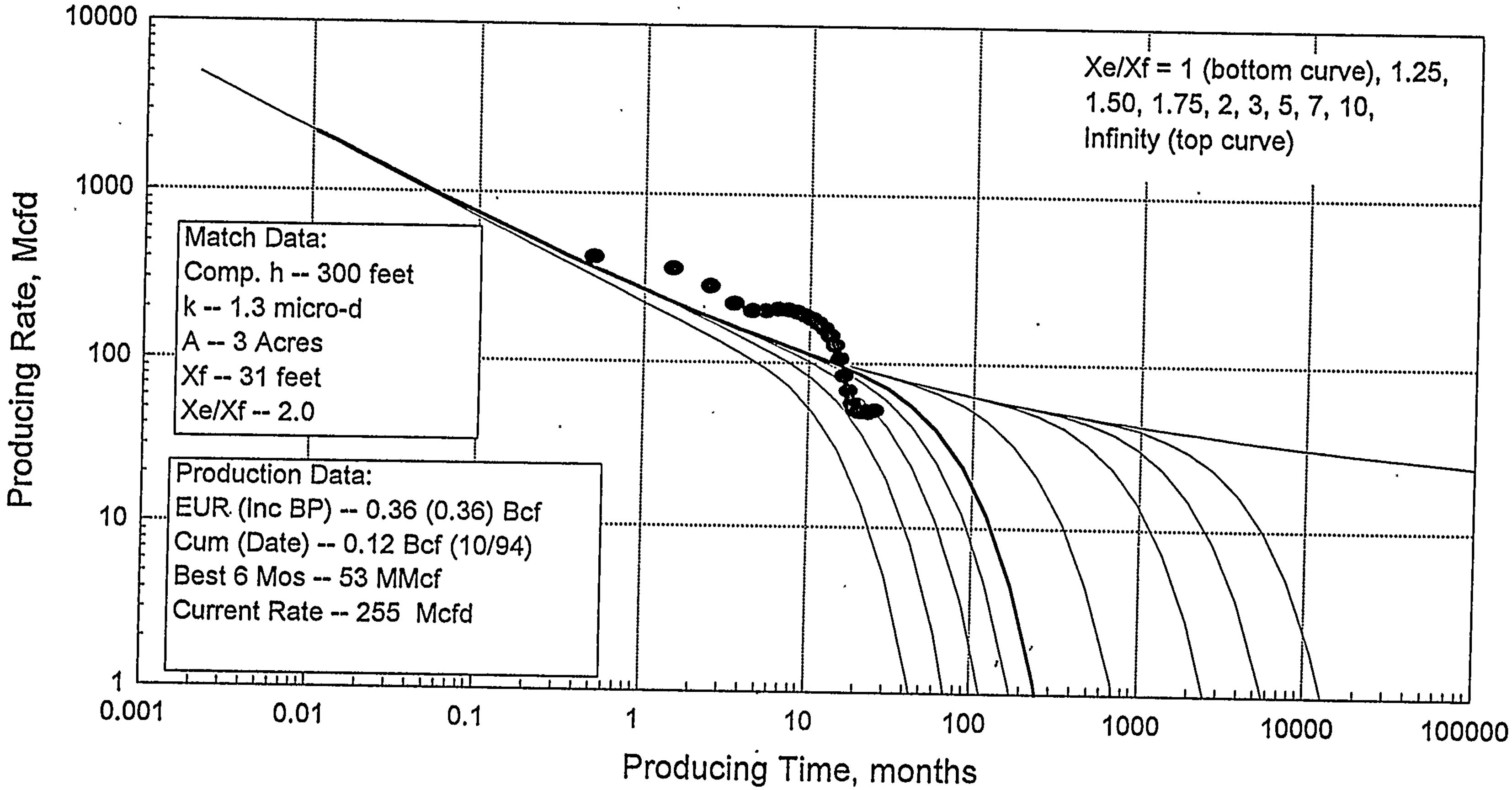
Shaeffer, J. #1

(Ye/Xe=1)

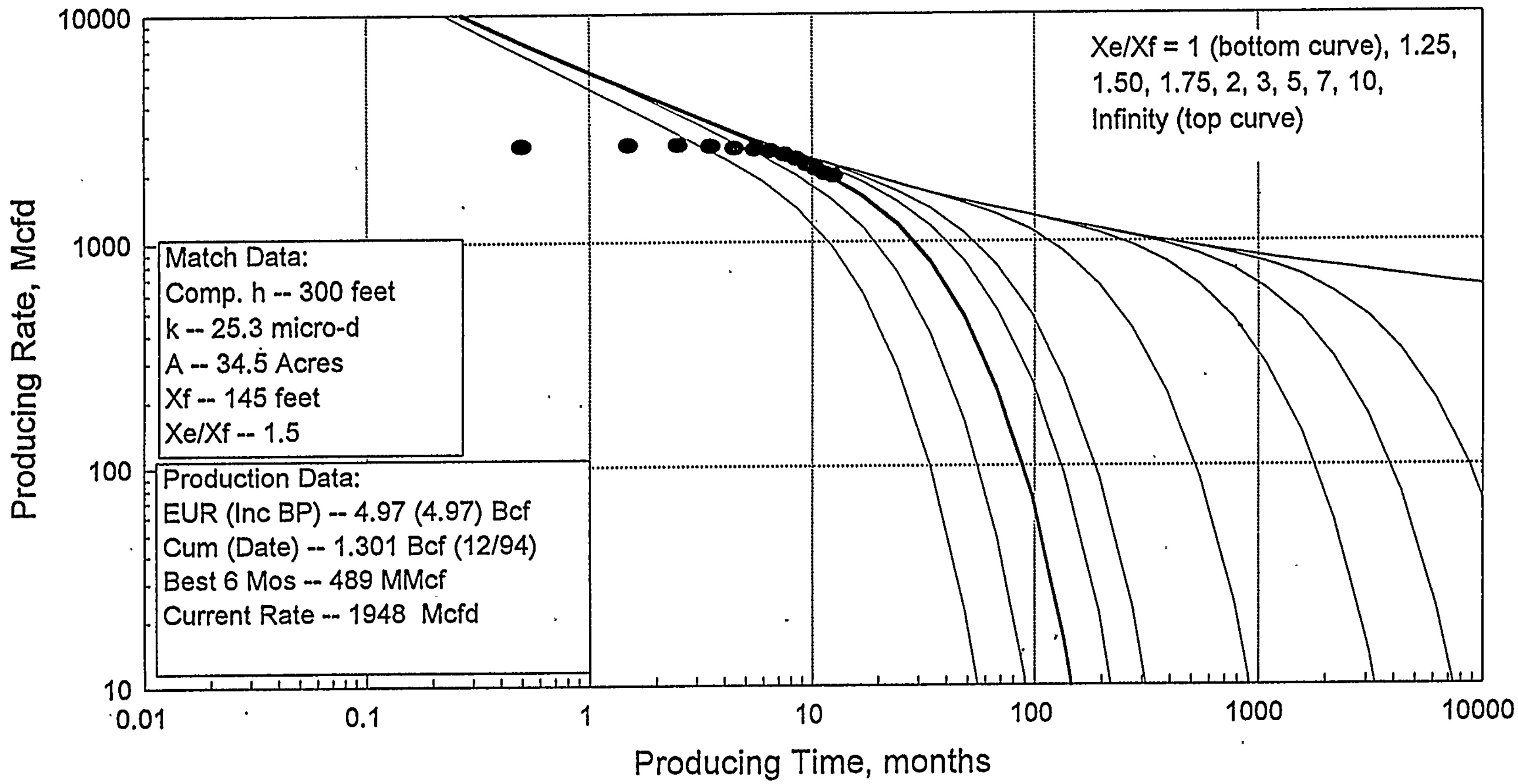


Shideler #25-10

(Ye/Xe=1)



RU 11-7
(Ye/Xe=1)



Xe/Xf = 1 (bottom curve), 1.25, 1.50, 1.75, 2, 3, 5, 7, 10, Infinity (top curve)
Match Data:
Comp. h -- 300 feet
k -- 25.3 micro-d
A -- 34.5 Acres
Xf -- 145 feet
Xe/Xf -- 1.5
Production Data:
EUR (Inc BP) -- 4.97 (4.97) Bcf
Cum (Date) -- 1.301 Bcf (12/94)
Best 6 Mos -- 489 MMcf
Current Rate -- 1948 Mcfd
Producing Rate, Mcfd
10000
1000
100
10
0.01
0.1
1
10
100
1000
10000
Producing Time, months

APPENDIX B

Multi-Azimuth 3-D P-wave Siemic Acquisition, Rulison Pilot Area

Key Features of Multi-azimuth 3D P-Wave Seismic Acquisition at Rulison Pilot Area

- **Purpose:**
  1. Design and acquire 3D P-wave data set in an area of high fracture permeability and anisotropy.
  2. Determine ability to map main fault systems.
  3. Establish P-wave seismic attributes that reliably correspond to orientation and intensity of open natural fractures.

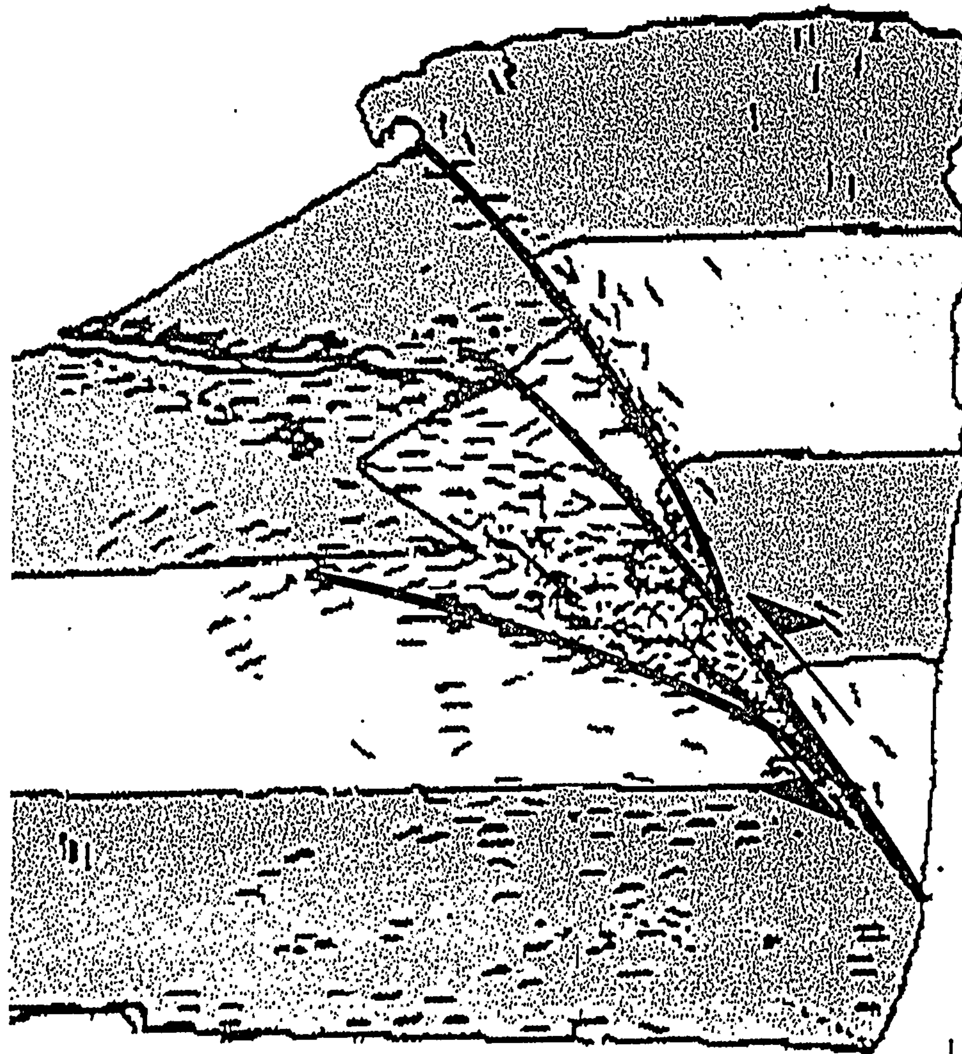
- **Design:**
  1. Full-azimuth, high-fold, full-offset 3D data set covering 4.5 mi^2.
  2. Receiver spacing of 220 feet (bin size of 110' by 110')

Detailed Mapping of Fault and Fracture Systems

The high quality 3D P-wave data set enabled the complex fault and fracture system in the Rulison Field to be mapped:

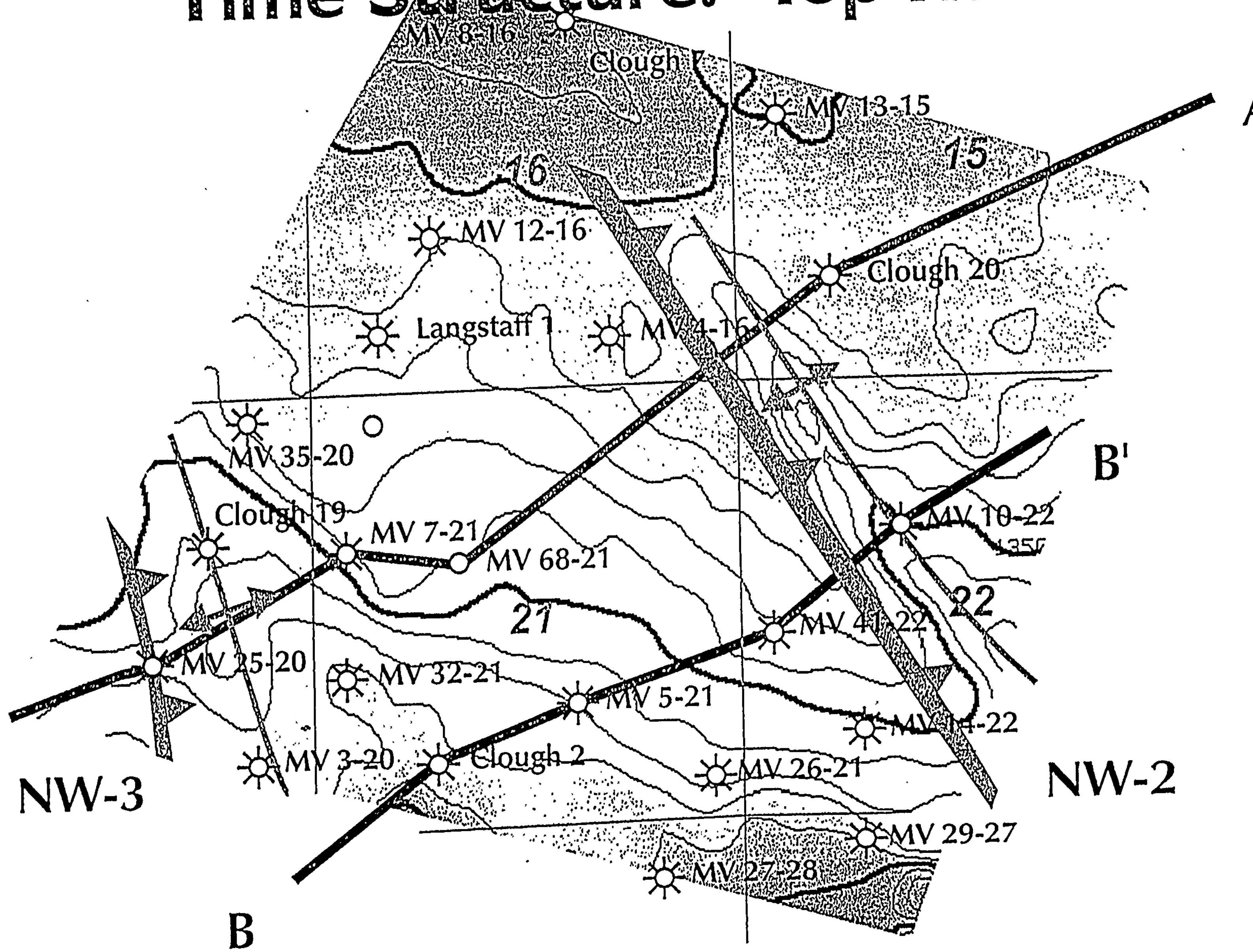
- Mapping identified a subtle, basement-related reverse fault, NW2.
- The NW2 fault, intersects the pay interval at a relatively low angle from top of Rollins through the gas saturated Mesaverde.
- The fault terminates with a cluster of fractures at top of gas saturated Mesaverde.

Fractures Developed Along a Reverse Fault

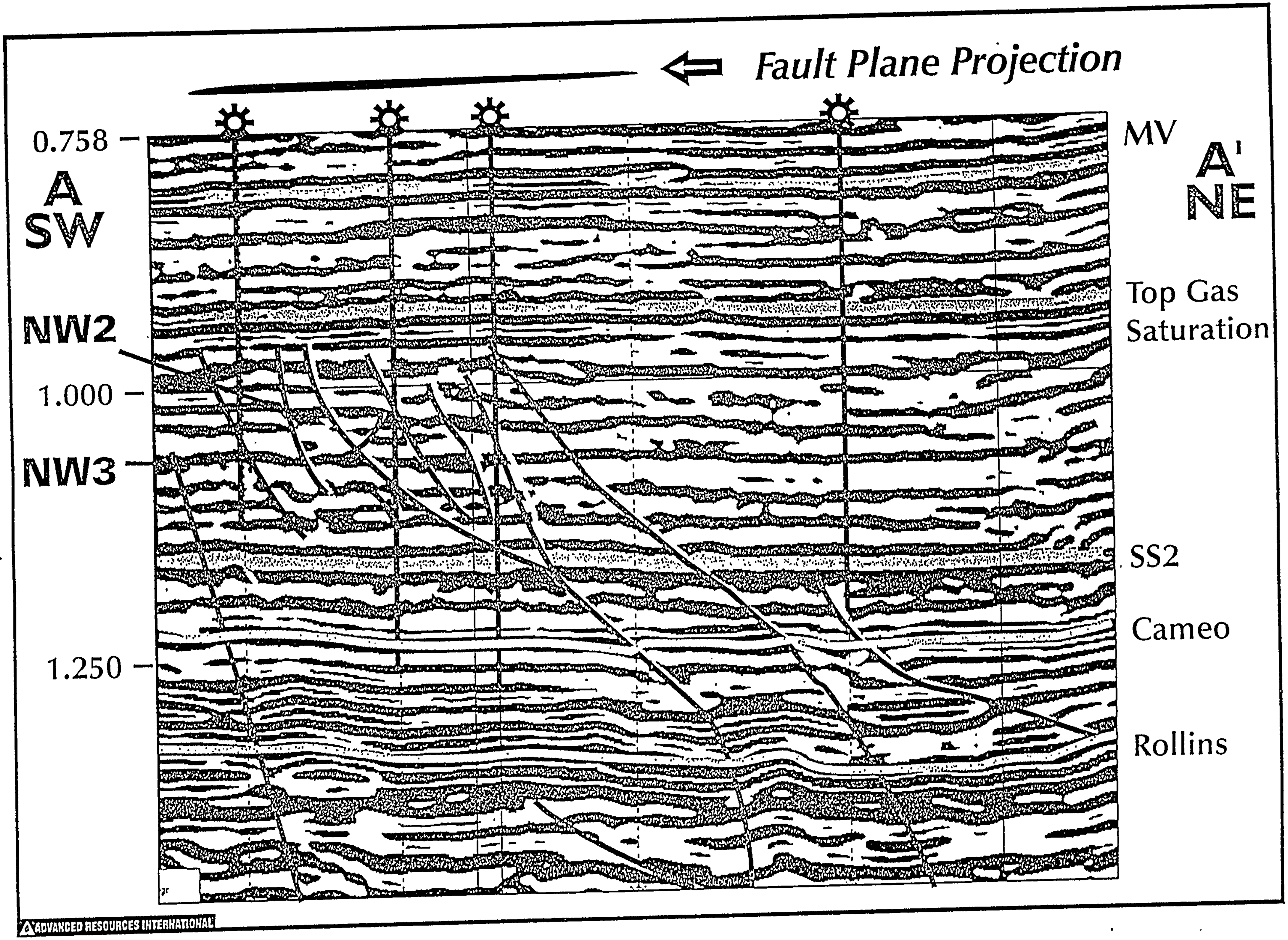


Logan, et al 1979

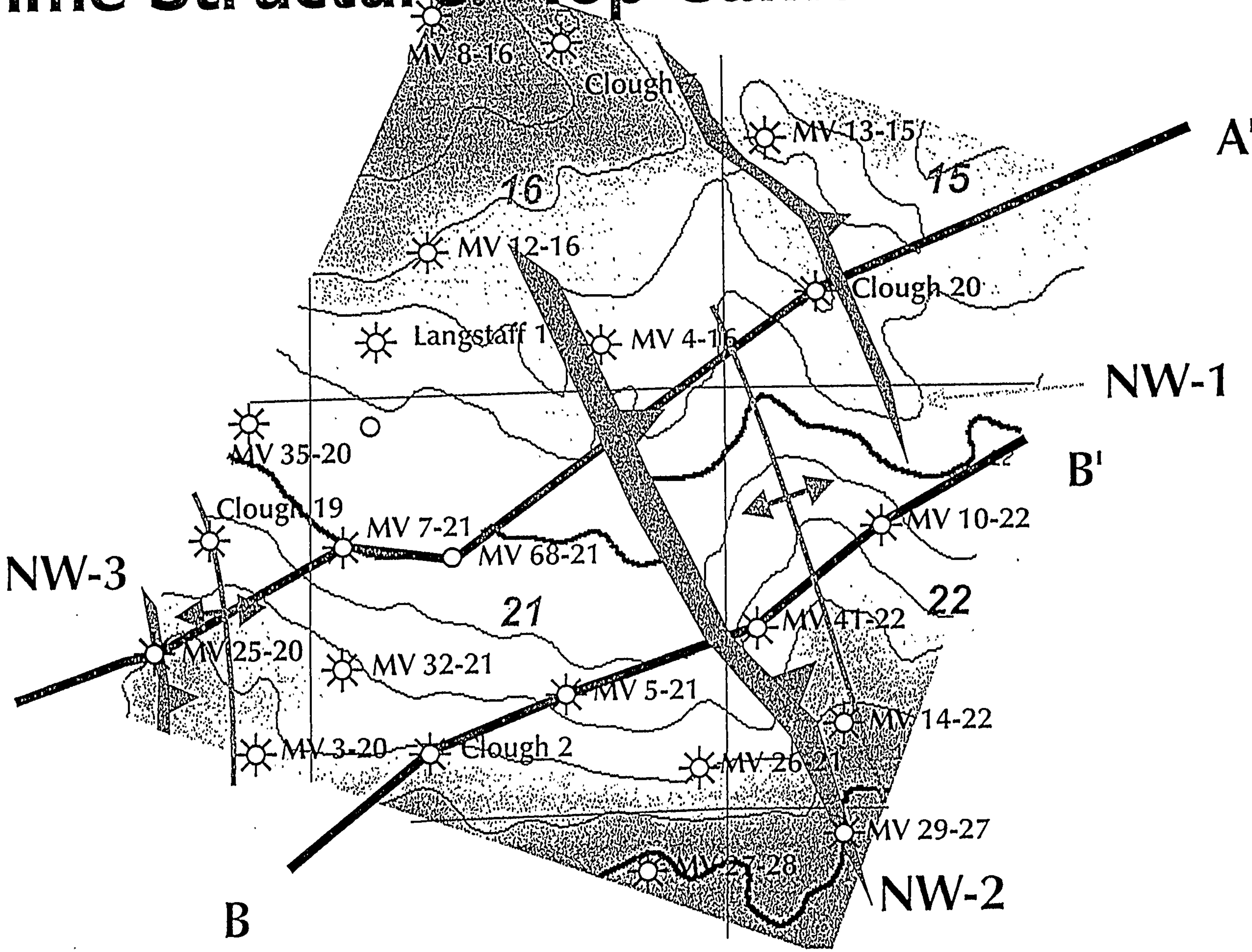
Time Structure: Top Rollins SS.

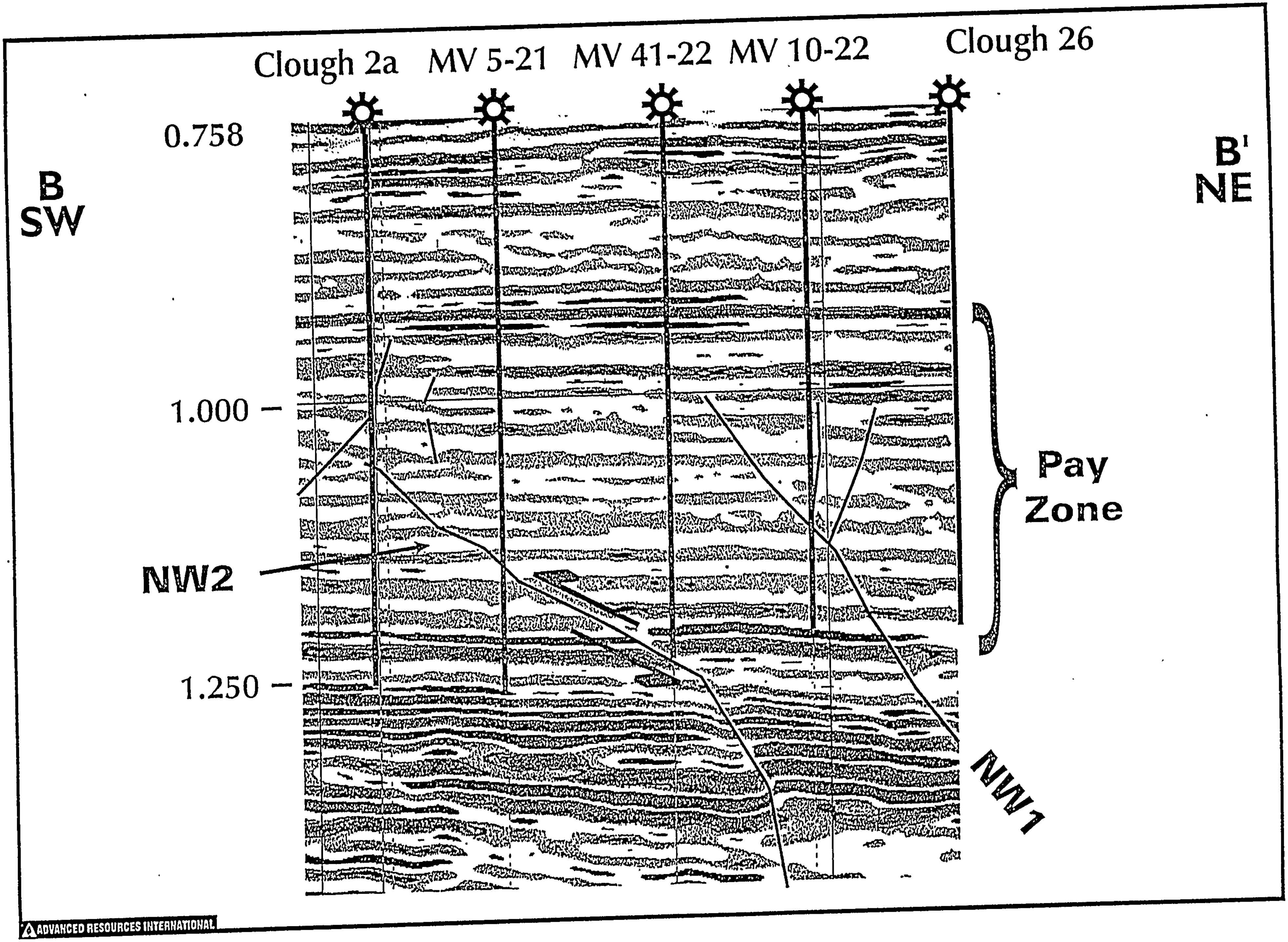


ADVANCED RESOURCES INTERNATIONAL


Fault Plane Projection
0.758
A
SW
NW2
1.000
NW3
1.250
MV
A'
NE
Top Gas
Saturation
SS2
Cameo
Rollins
ADVANCED RESOURCES INTERNATIONAL

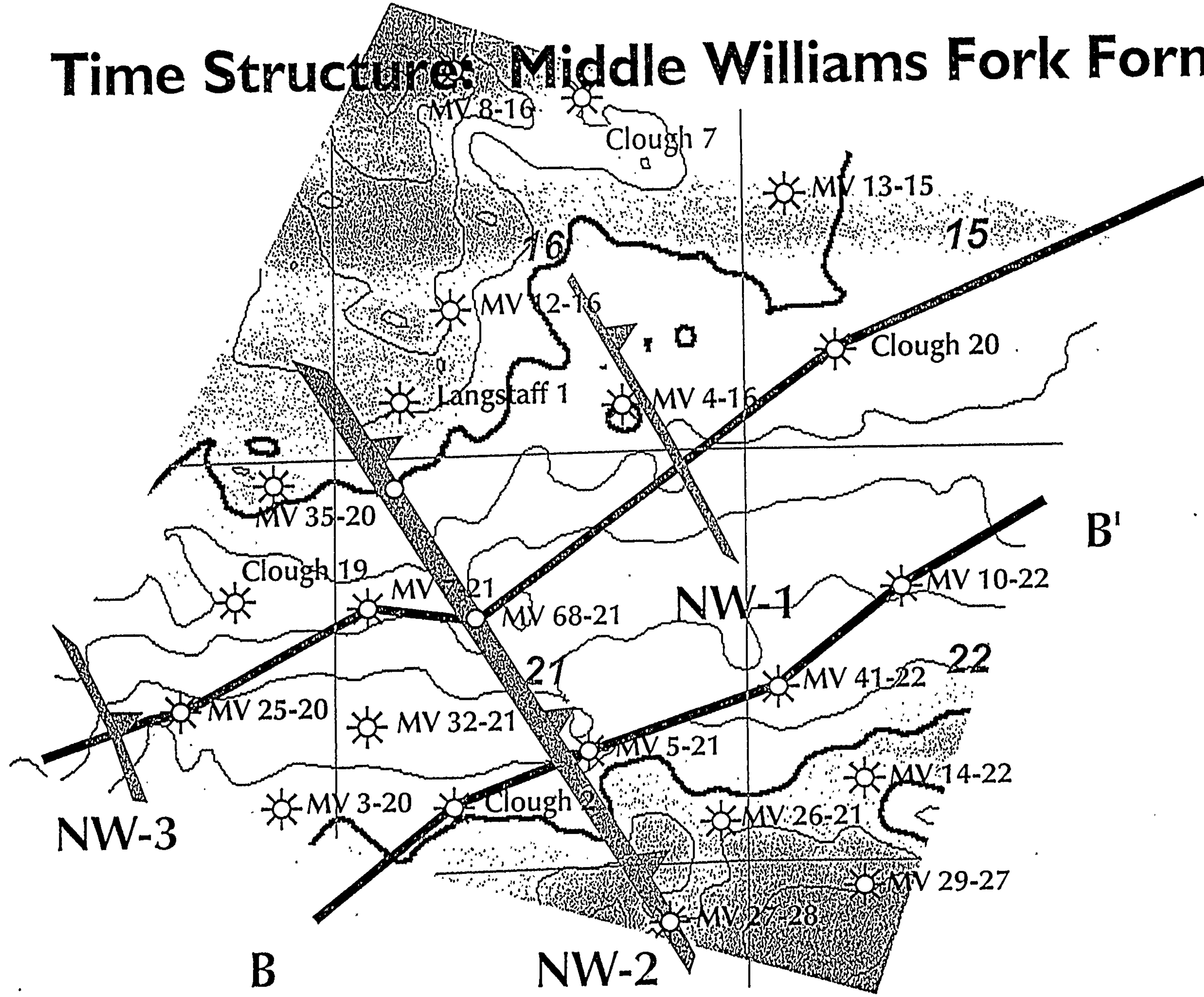
Time Structure: Top Cameo Coal Group



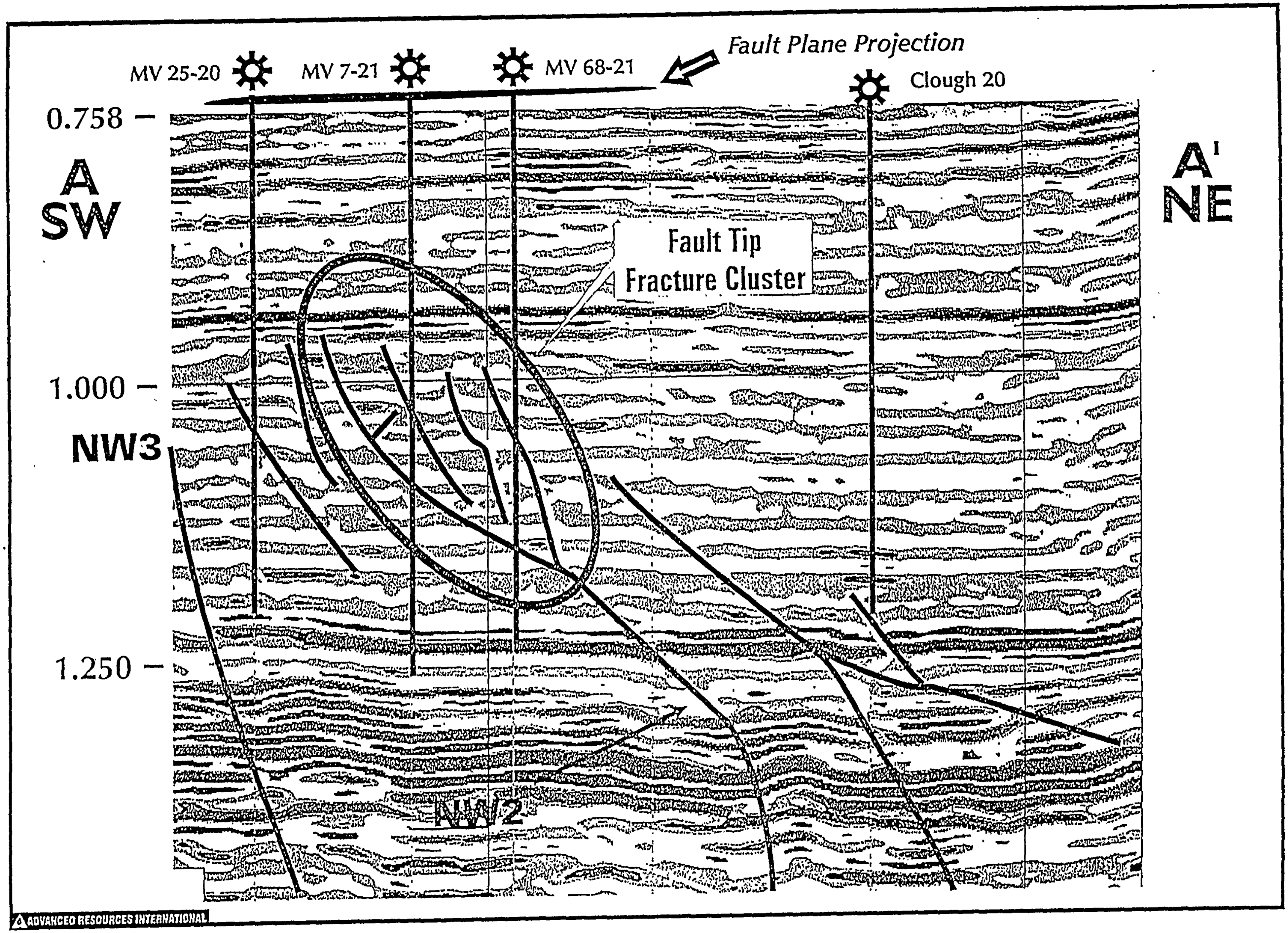


Clough 2a
MV 5-21
MV 41-22
MV 10-22
Clough 26
0.758
B
SW
B'
NE
1.000
1.250
NW2
NW1
Pay Zone
ADVANCED RESOURCES INTERNATIONAL

Time Structure: Middle Williams Fork Formation

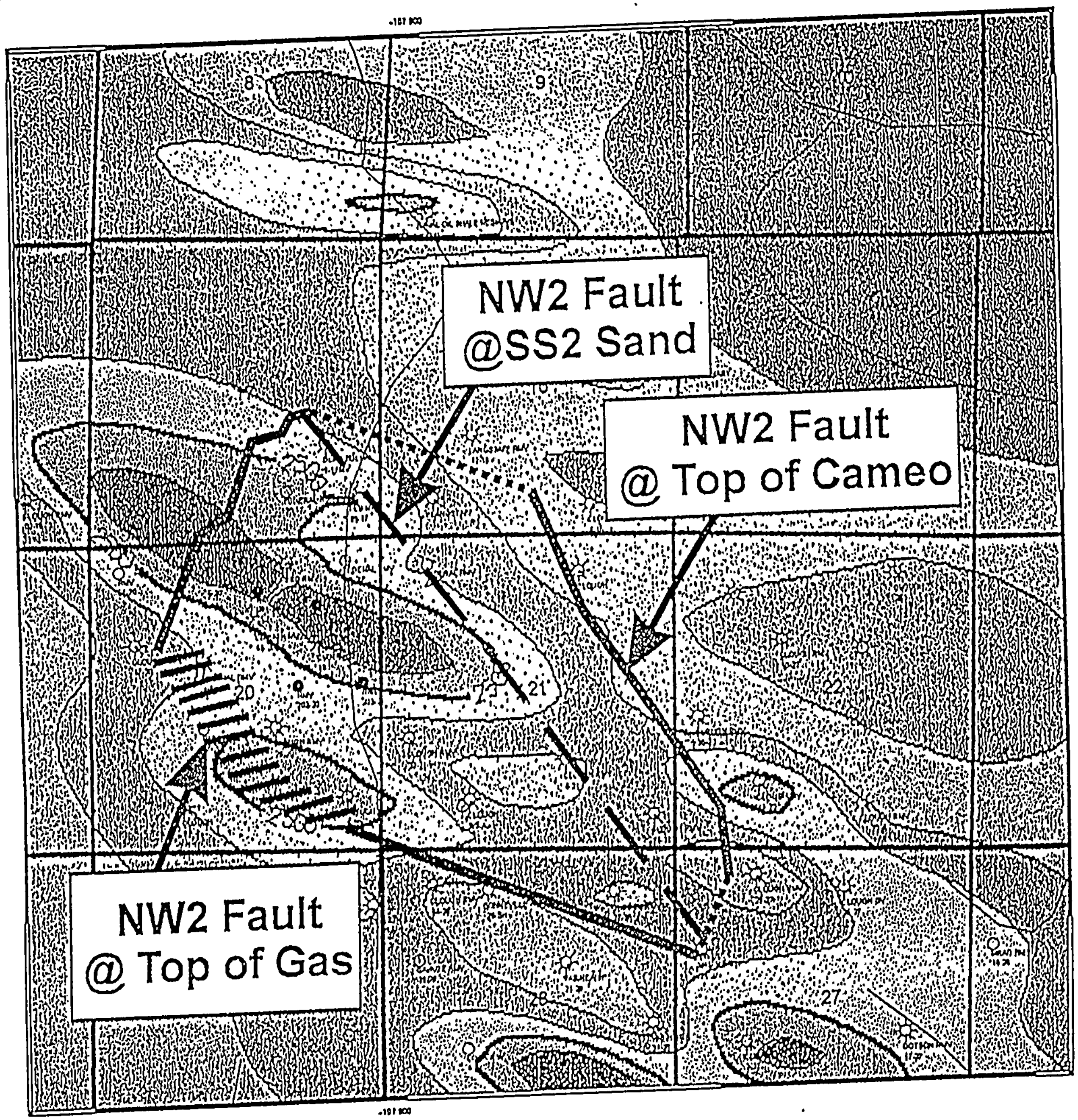


ADVANCED RESOURCES INTERNATIONAL



Fault Plane Projection
MV 25-20
MV 7-21
MV 68-21
Clough 20
0.758
1.000
1.250
A
SW
A'
NE
NW3
NW2
Fault Tip
Fracture Cluster
ADVANCED RESOURCES INTERNATIONAL

Outline of NW2 Fault Zone, Rulison Field



Correlation of NW2 Fault Zone With Well Performance

Wells Drilled In The Low Angle NW2 Fault Zone (from top of Cameo to top of Gas Saturation) Have Higher Estimated Reserves).

	Inside NW2 Fault Zone	Outside NW2 Fault Zone
No. Wells	17	10
Avg. EUR/Well	2.32 Bcf	1.37 Bcf
Range of EUR/Well*	1.57 to 3.26 Bcf	0.98 to 1.84 Bcf
Wells Within FTC (14)	2.47 Bcf	——
Wells Outside FTC (3)	1.66 Bcf	——

*After eliminating best and worst wells.