

saskøil

WEST KIRKELLA AREA

Pressure Survey and Fluid Analysis

0954C



1500 Chateau Tower 1920 Broad Street  
P.O. Box 3550  
Regina, Saskatchewan S4P 3C4  
Telephone (306) 565-7000

February 11, 1982

Manitoba Department of Energy and Mines  
Mineral Resources Division  
Petroleum Branch  
989 Century Street  
WINNIPEG, Manitoba  
R3H 0W4

ATTENTION: Mr. L. Robert Dubreuil  
Chief Petroleum Engineer

Dear Sir:

Re: Pressure Survey and Fluid Sample Analysis  
West Kirkella Area

Attached for your inspection are the reservoir fluid study, water analysis, and pressure buildup study as requested.

A pressurized bottom hole fluid sample was obtained from 5-18-12-29 WPM and the corresponding PVT analysis is presented. The results of a separator test are shown and it is found that the stock tank oil gravity (at standard conditions) is 26.2 API. The gas/oil ratio measured is 1.77. The formation volume factor is 1.024. The saturation pressure is 586 kPa (gauge) at reservoir temperature.

An analysis of produced water from 13-18-12-29 WPM (sampled at wellhead) is attached. Some notable results are a resistivity of 0.170 ohm/meters at 25°C and a pH of 6.6.

A pressure buildup survey was conducted at 12-18 and 5-18-12-29 WPM. An extrapolated reservoir pressure of 983 psig (6775 kPag) is exhibited at 12-18. An average reservoir pressure of 987 psig (6805 kPag) is found for 5-18. Permeability is very high due to the fracture system present in the formation.

Saskatchewan Oil and Gas Corporation

A pressure buildup survey is proposed for the West Kirkella area this coming fall to assess the need for pressure maintenance.

If you have any questions regarding this submission please contact myself or Gene Kowch.

Yours truly,



R.M. Decker  
Junior Petroleum Engineer

BD/tk

PVT Study

CORE LABORATORIES-CANADA, LTD.



1981-11-27

Saskatchewan Oil and Gas Corporation  
1500, 1920 Broad Street  
Regina, Saskatchewan  
S4P 3V2

Attention: Mr. Bob Decker

Reservoir Fluid Study

Saskoil West Kirkella 5-18-12-29 (WIM)  
West Kirkella Field, Manitoba, Canada  
Our File Number: 7013-81-247

Gentlemen:

Subsurface samples of reservoir fluid were taken from the above subject well by a representative of Core Laboratories-Canada Ltd. on 1981-10-29 and submitted to our laboratory for a reservoir fluid study.

A portion of the reservoir fluid was transferred at high pressure to a high pressure-windowed cell and then heated at a constant pressure to the reported reservoir temperature of 28.9°C. The pressure-volume relations of the fluid were measured during a constant expansion down to 586 kPa (gauge). The saturation pressure was determined to be 586 kPa (gauge) at 28.9°C. The results of this test are shown on pages 1 and 2 of this report.

The viscosity of the fluid was determined at 28.9°C from 34 474 kPa (gauge) down to 689 kPa (gauge). This data is summarized on page 3.

One separator flash test was performed at 0 kPa (gauge) and 26.7°C. The results of this test are on page 4.

The composition of the reservoir fluid was determined by low temperature, fractional distillation and is shown on pages 5 and 6.

Thank you for the opportunity to perform this study for you. Should you have any questions concerning this data, please contact us.

Yours truly,

CORE LABORATORIES-CANADA LTD.

A handwritten signature in dark ink, appearing to read "Tom B. Martin". The signature is fluid and cursive, with a large, stylized "M" at the end.

Tom B. Martin

TG:cd

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*Petroleum Reservoir Engineering*  
 CALGARY, ALBERTA

Page 1 of 8  
 File 7013-81-247  
 Well Saskoil West  
Kirkella 5-18-12-29 (W1M)

VOLUMETRIC DATA OF RESERVOIR FLUID SAMPLE

1. Saturation pressure (bubble point pressure) 586 kPa (gauge) @ 28.9 °C
2. Thermal expansion of saturated oil @ 34 474 kPa (gauge) =  $\frac{V@ 28.9 \text{ °C}}{V@ 21.7 \text{ °C}}$  = 1.00500
3. Density at saturation pressure: 889.2 kg/m<sup>3</sup> @ 28.9 °C
4. Compressibility of saturated oil @ reservoir temperature: Vol/ Vol/MPa:
 

From	<u>586</u>	kPa to	<u>3 447</u>	kPa =	<u><math>8.41 \times 10^{-4}</math></u>
From	<u>3 447</u>	kPa to	<u>6 895</u>	kPa =	<u><math>6.70 \times 10^{-4}</math></u>
From	<u>6 895</u>	kPa to	<u>13 790</u>	kPa =	<u><math>6.44 \times 10^{-4}</math></u>
From	<u>13 790</u>	kPa to	<u>20 684</u>	kPa =	<u><math>6.03 \times 10^{-4}</math></u>
From	<u>20 684</u>	kPa to	<u>27 579</u>	kPa =	<u><math>5.76 \times 10^{-4}</math></u>
From	<u>27 579</u>	kPa to	<u>34 474</u>	kPa =	<u><math>5.63 \times 10^{-4}</math></u>

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File 7013-81-247

Well Saskoil West Kirkella

5-18-12-29 (W1M)

## PRESSURE-VOLUME RELATIONS AT 28.9°C

<u>Gauge Pressure, kPa</u>	<u>Relative Volume, V/Vsat (1)</u>
34 474	0.9791
31 026	0.9810
27 579	0.9829
24 132	0.9849
20 684	0.9868
17 237	0.9888
13 790	0.9909
10 342	0.9930
6 895	0.9953
3 447	0.9976
2 758	0.9981
2 068	0.9987
<u>586</u>	<u>1.0000</u>

(1) Cubic metres at indicated pressure and temperature per cubic meter of saturated oil.

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File 7013-81-247

Well Saskoil West

Kirkella 5-18-12-29 (W1M)

VISCOSITY AT 28.9°C

<u>Gauge Pressure, kPa</u>	<u>Oil Viscosity, mPa•s</u>
34 474	35.871
31 026	33.923
27 579	31.881
24 132	29.885
20 684	27.840
17 237	25.842
13 790	23.890
10 342	21.843
6 895	19.842
3 447	17.887
689	16.350



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File 7013-81-247

Well Saskoil West

Kirkella 5-18-12-29 (W1M)

## SEPARATOR TEST OF RESERVOIR FLUID SAMPLE

Separator Gauge Pressure, kPa	Separator Temperature °C	Gas/Oil Ratio (1)	Gas/Oil Ratio (2)	Stock Tank Oil Gravity, °API @ 15.56°C	Formation Volume Factor (3)	Separator Volume Factor (4)	Relative Density of Liberated Gas (AIR = 1.000)
--	--------------------------------	-------------------------	-------------------------	--	--------------------------------------	--------------------------------------	--

0	26.7	1.77	1.77	26.2	1.024	1.008	1.140
---	------	------	------	------	-------	-------	-------

	Total		1.77				
--	-------	--	------	--	--	--	--

- (1) Cubic metres of gas @ 101.325 kPa (absolute) and 15°C per cubic metre of oil @ indicated pressure and temperature.
- (2) Cubic metres of gas @ 101.325 kPa (absolute) and 15°C per cubic metre of stock tank oil @ 15°C.
- (3) Cubic metres of saturated oil @ 586 kPa (gauge) and 28.9 °C per cubic metre of stock tank oil @ 15°C.
- (4) Cubic metres of oil @ indicated pressure and temperature per cubic metre of stock tank oil @ 15°C.



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Petroleum Reservoir Engineering  
CALGARY ALBERTA



B148

HYDROCARBON LIQUID ANALYSIS

7013-81-247

CONTAINER IDENTITY

LABORATORY NUMBER

Saskatchewan Oil and Gas Corporation

5 of 8

PAGE

LSD 5-18-12-29 WIM

Saskoil West Kirkella 5-18-12-29

LOCATION

WELL OR SAMPLE LOCATION NAME

KB ELEV., m

GRD. ELEV., m

West Kirkella, Manitoba

FIELD OR AREA

POOL OR ZONE

SAMPLER

TEST TYPE & NO.

TEST RECOVERY

Bottom Hole

@ °C

POINT OF SAMPLE

AMT. & TYPE CUSHION

MUD RESISTIVITY

PUMPING

FLOWING

GAS LIFT

SWAB

WATER

m<sup>3</sup>/d

OIL

m<sup>3</sup>/d

GAS

m<sup>3</sup>/d

TEST INTERVALS OR PERFS., m

SEPARATOR RESERVOIR

@ °C  
CONTAINER  
WHEN SAMPLED

@ °C  
CONTAINER  
WHEN RECEIVED

SEPARATOR

PRESSURES, kPa (gauge)

TEMPERATURES, °C

1981-10-29

1981-11-19

1981-11-23

DATE SAMPLED (Y/M/D)

DATE RECEIVED (Y/M/D)

DATE ANALYSED (Y/M/D)

ANALYST

REMARKS

COMPONENT	MOLE FRACTION	MASS FRACTION	LIQUID VOL FRACTION
N <sub>2</sub>	.0035	.0004	.0004
CO <sub>2</sub>	.0060	.0011	.0012
H <sub>2</sub> S	.0049	.0007	.0008
C <sub>1</sub>	.0003	.0000	.0001
C <sub>2</sub>	.0070	.0009	.0022
C <sub>3</sub>	.0260	.0046	.0082
iC <sub>4</sub>	.0144	.0034	.0054
C <sub>4</sub>	.0239	.0057	.0087
iC <sub>5</sub>	.0221	.0065	.0093
C <sub>5</sub>	.0060	.0017	.0025
C <sub>6</sub> <sup>+</sup>	.8859	.9750	.9612
TOTAL	1.0000	1.0000	1.0000

OBSERVED PROPERTIES OF C<sub>6</sub><sup>+</sup> RESIDUE (15/15° C)

911.8  
DENSITY kg/m<sup>3</sup>

.9126  
RELATIVE DENSITY

23.6  
API @ 15.5° C

271

RELATIVE MOLECULAR MASS

CALCULATED PROPERTIES OF TOTAL SAMPLE (15/15° C)

898.9  
DENSITY kg/m<sup>3</sup>

.8997  
RELATIVE DENSITY

25.8  
API @ 15.5° C

246.23

RELATIVE MOLECULAR MASS

REMARKS

CORE LABORATORIES-CANADA LTD.

COMPANY Saskatchewan Oil and Gas Corporation  
 LOCATION LSD 5-18-12-29 W1M  
 SAMPLED FROM Bottom Hole

PAGE 6 of 8  
 FILE 7013-81-247

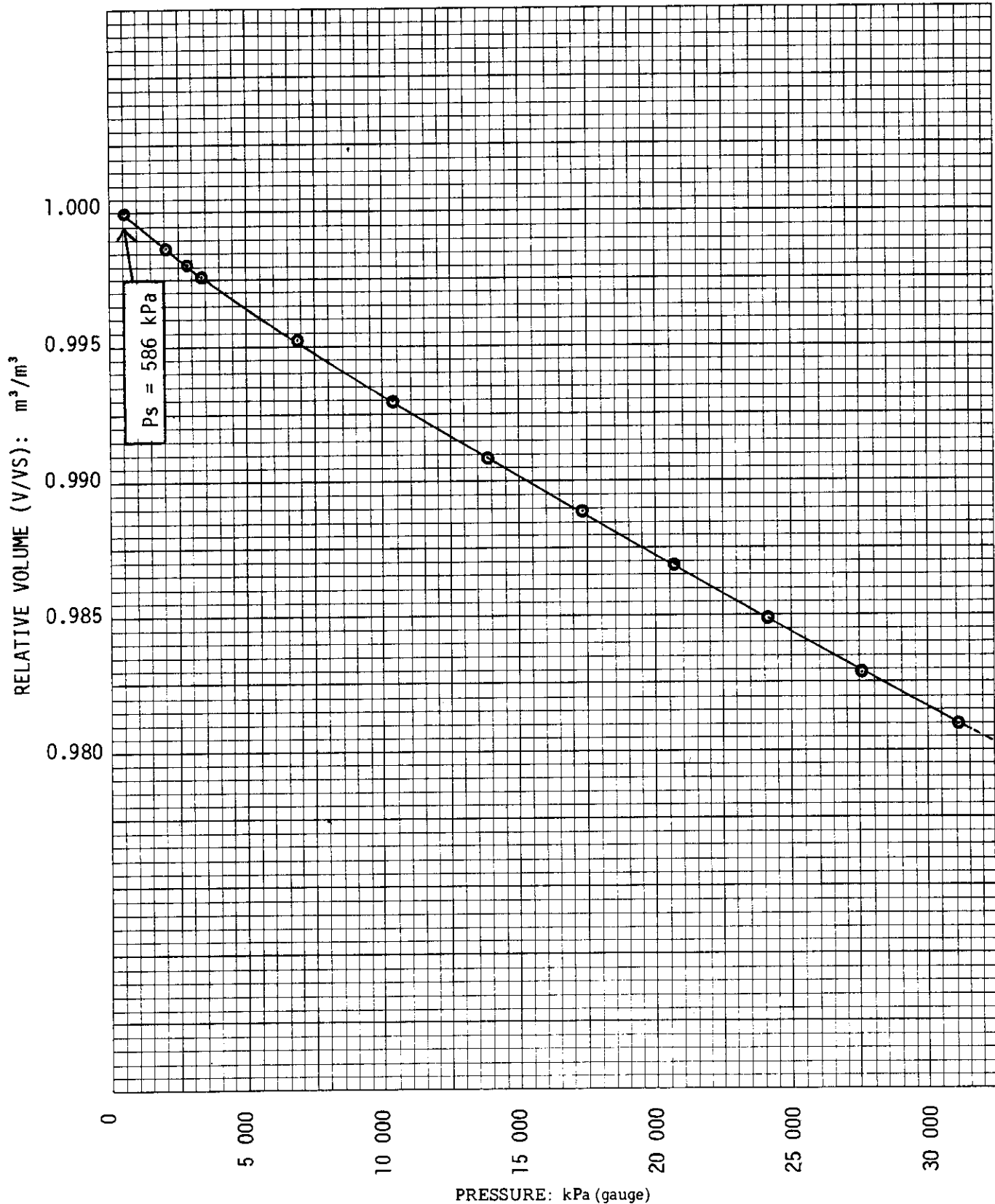
Analysis of C<sub>6</sub>+ Fraction to C<sub>30</sub>+

<u>Boiling Point Range (°C)</u>	<u>Component</u>	<u>Carbon Number</u>	<u>Mole Fraction</u>	<u>Mass Fraction</u>
36.1- 68.9	Hexanes	C <sub>6</sub>	.0149	.0055
68.9- 98.3	Heptanes	C <sub>7</sub>	.0376	.0160
98.3-125.6	Octanes	C <sub>8</sub>	.0504	.0244
125.6-150.6	Nonanes	C <sub>9</sub>	.0445	.0242
150.6-173.9	Decanes	C <sub>10</sub>	.0498	.0300
173.9-196.1	Undecanes	C <sub>11</sub>	.0484	.0321
196.1-215.0	Dodecanes	C <sub>12</sub>	.0470	.0339
215.0-235.0	Tridecanes	C <sub>13</sub>	.0407	.0318
235.0-252.2	Tetradecanes	C <sub>14</sub>	.0452	.0380
252.2-270.6	Pentadecanes	C <sub>15</sub>	.0374	.0337
270.6-287.8	Hexadecanes	C <sub>16</sub>	.0384	.0369
287.8-302.8	Heptadecanes	C <sub>17</sub>	.0289	.0295
302.8-317.2	Octadecanes	C <sub>18</sub>	.0313	.0338
317.2-330.0	Nonadecanes	C <sub>19</sub>	.0274	.0311
330.0-344.4	Eicosanes	C <sub>20</sub>	.0228	.0274
344.4-357.2	Heneicosanes	C <sub>21</sub>	.0218	.0273
357.2-369.4	Docosanes	C <sub>22</sub>	.0189	.0249
369.4-380.0	Tricosanes	C <sub>23</sub>	.0182	.0251
380.0-391.1	Tetracosanes	C <sub>24</sub>	.0151	.0217
391.1-401.7	Pentacosanes	C <sub>25</sub>	.0139	.0207
401.7-412.2	Hexacosanes	C <sub>26</sub>	.0125	.0194
412.2-422.2	Heptacosanes	C <sub>27</sub>	.0117	.0188
422.2-431.7	Octacosanes	C <sub>28</sub>	.0111	.0186
431.7-441.1	Nonacosanes	C <sub>29</sub>	.0103	.0179
441.1 Plus	triacontanes Plus	C <sub>30</sub> +	.1290	.3280
<u>AROMATICS</u>				
80.0	Benzene	C <sub>6</sub> H <sub>6</sub>	.0011	.0003
110.6	Toluene	C <sub>7</sub> H <sub>8</sub>	.0054	.0021
136.1-138.9	Ethylbenzene, p + m-Xylene	C <sub>8</sub> H <sub>10</sub>	.0126	.0057
144.4	o-Xylene	C <sub>8</sub> H <sub>10</sub>	.0055	.0025
168.9	1,2,4 Trimethylbenzene	C <sub>9</sub> H <sub>12</sub>	.0060	.0030
<u>NAPHTHENES</u>				
68.9	Cyclopentane	C <sub>5</sub> H <sub>10</sub>	.0003	.0001
72.2	Methylcyclopentane	C <sub>6</sub> H <sub>12</sub>	.0074	.0026
81.1	Cyclohexane	C <sub>6</sub> H <sub>12</sub>	.0087	.0031
101.1	Methylcyclohexane	C <sub>7</sub> H <sub>14</sub>	.0117	.0049
	TOTAL		.8859	.9750
	Mole Fraction of C <sub>7</sub> +			.8535
	Mass Fraction of C <sub>7</sub> +			.9634
	Calculated Relative Molecular Mass of C <sub>7</sub> +			278.
	Calculated Relative Density of C <sub>7</sub> +			.9156
	Calculated Density of C <sub>7</sub> + (kg/m <sup>3</sup> )			914.7

The above boiling point ranges refer to the normal paraffin hydrocarbon boiling in that range. Other hydrocarbons (aromatics, olefins, naphthenes and branched hydrocarbons) may have higher or lower carbon numbers, but are grouped and reported according to their boiling point.

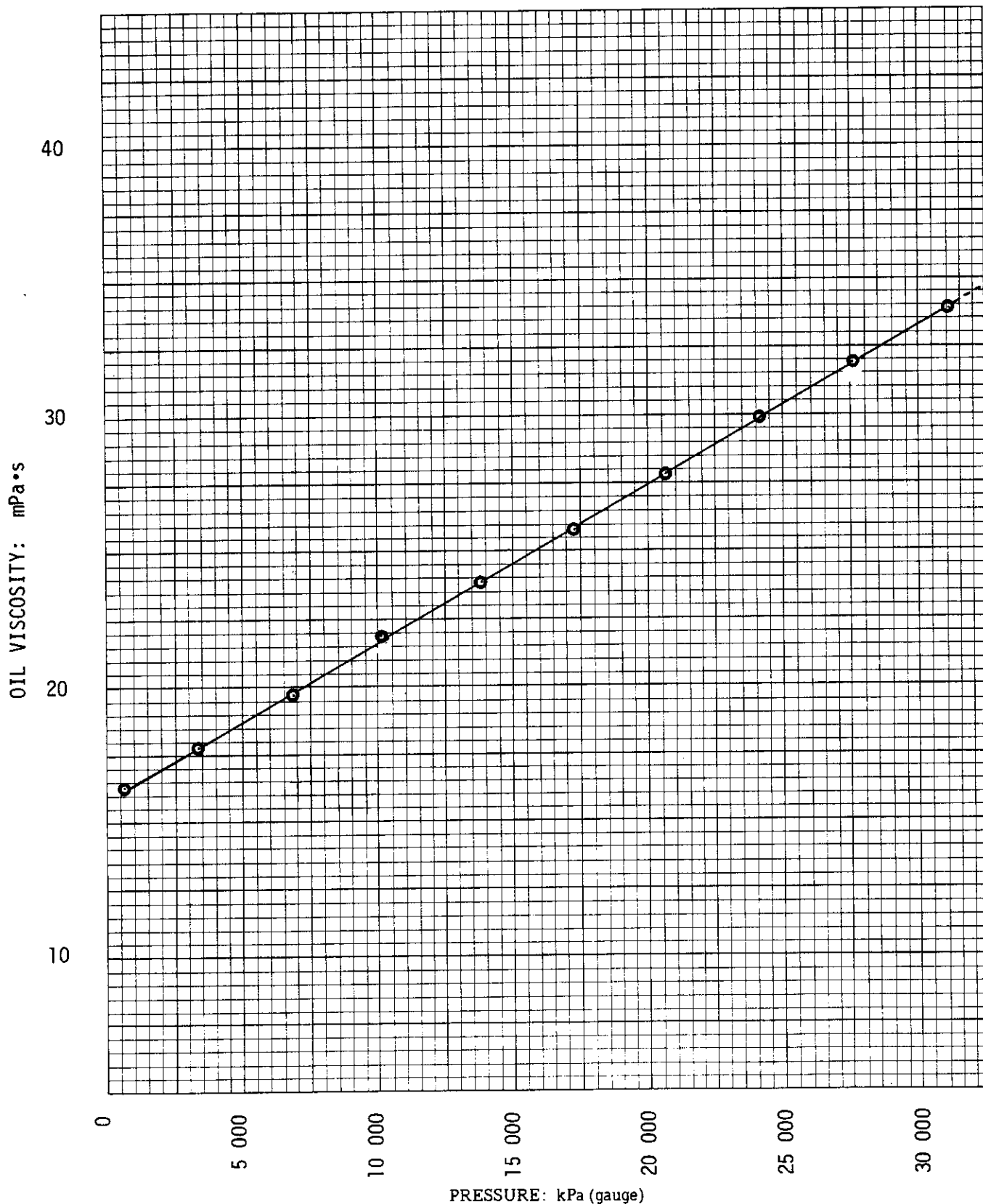
RELATIVE VOLUME (V/V<sub>S</sub>) AT 28.9°C

Company	Saskatchewan Oil and Gas Corporation	Formation	
Well	Saskoil West Kirkella 5-18-12-29 (W1M)	Province	Manitoba
Field	West Kirkella	Country	Canada



OIL VISCOSITY AT 28.9°C

Company	Saskatchewan Oil and Gas Corporation	Formation	
Well	Saskoil West Kirkella 5-18-12-29 (W1M)	Province	Manitoba
Field	West Kirkella	Country	Canada



Water Analysis



CORE LABORATORIES - CANADA LTD.  
Petroleum Reservoir Engineering  
CALGARY ALBERTA



Plastic

CONTAINER IDENTITY

WATER ANALYSIS

7023-81-201

LABORATORY NUMBER

Saskatchewan Oil And Gas Corporation

1 of 1

LSD 13-18-29-1 W1M

LOCATION

West Kirkella 13-18-29-1

WELL OR SAMPLE LOCATION NAME

539.9

KB ELEV.

536.2

GRD. ELEV.

Kirkella, Manitoba

FIELD OR AREA

Lower Daly

POOL OR ZONE

Bob Decker

SAMPLER

4 Litres of Water

TEST TYPE & NO.

TEST RECOVERY

Wellhead

POINT OF SAMPLE

AMT. & TYPE CUSHION

MUD RESISTIVITY

763.5 - 765

PUMPING

FLOWING

GAS LIFT

SWAB

758.5 - 760.5

WATER

m<sup>3</sup>/d

OIL

m<sup>3</sup>/d

GAS

m<sup>3</sup>/d

TEST INTERVALS OR PERFS.

SEPARATOR RESERVOIR

CONTAINER WHEN SAMPLED

CONTAINER WHEN RECEIVED

SEPARATOR

PRESSURES, kPa

TEMPERATURES, °C

81 10 29

81 11 02

81 11 02

SS

DATE SAMPLED (Y/M/D)

DATE RECEIVED (Y/M/D)

DATE ANALYSED (Y/M/D)

ANALYST

REMARKS

ION	mg/L	mg Fraction	MEQ/L
Na	12000	.3174	522.0
K	310	.0082	7.9
Ca	1366	.0361	68.2
Mg	465	.0123	38.3
Ba			
Sr			
Fe	NOT DETECTED		

ION	mg/L	mg Fraction	MEQ/L
Cl	18944	.5010	534.4
Br			
I			
HCO <sub>3</sub>	978	.0259	16.0
SO <sub>4</sub>	3746	.0991	78.0
CO <sub>3</sub>	0	.0000	.0
OH	0	.0000	.0
H <sub>2</sub> S	PRESENT		

TOTAL SOLIDS mg/L

BY EVAPORATION @ 110°C

BY EVAPORATION @ 180°C

37812

AT IGNITION

CALCULATED

1.0332 @ 15.4°C  
SPECIFIC GRAVITY

1.3400 @ 25  
REFRACTIVE INDEX

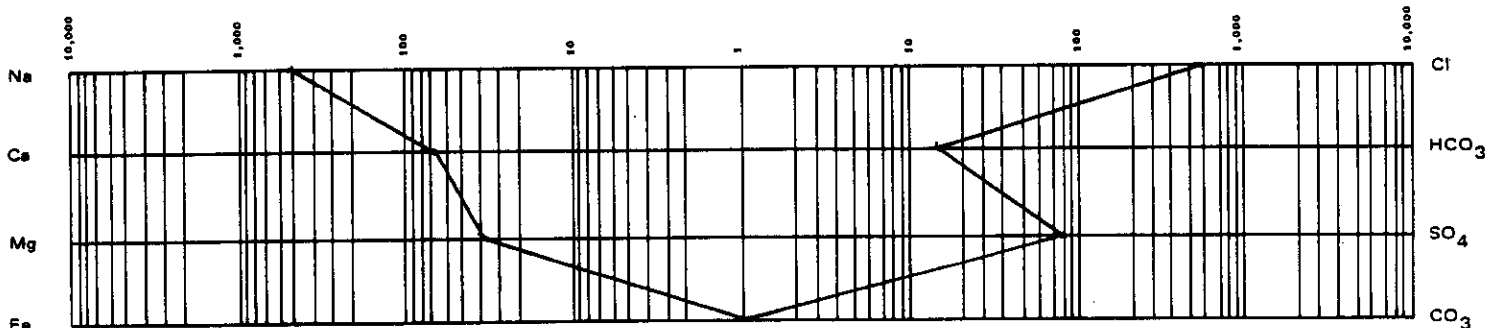
6.6

pH

.170 @ 25°C

RESISTIVITY (OHM/METERS)

LOGARITHMIC PATTERN MEQ PER LITRE



REMARKS

NaCl EQUIVALENT = 35623.

Pressure Survey





Pressure Buildup Test

ANALYSIS

KIRKELLA FIELD

Daly Formation

Prepared By:  
Gene Kowch, Dipl.T

Buildup Test

12-18-12-29 W1

CONCLUSION:

12-18 showed an extrapolated sandface pressure of 6775 Kpag. Comparison with virgin formation pressure from drillstem test analysis (May, 1981) shows no pressure depletion.

Based on PVT analysis values of 5-18, permeability calculations show a very high permeability of 42,505.9 md. This high value indicates a fractured formation, as confirmed by review of the  $\log \Delta T - \log \Delta P$  line slope of 1:4.

ANALYSIS:

$$\text{Slope } m = 1 \text{ kpag/cycle} = 0.145 \text{ psig/cycle}$$

PERMEABILITY DATA: Data from PVT analysis on 5-18

$$\begin{aligned} q &= 43.45 \text{ BFPD} & C_t &= 6.7 \times 10^{-4} \text{ (psi}^{-1}\text{)} \\ \mu &= 19.569 \text{ cp} & B &= 1.024 \\ \phi &= 0.08 & h &= 7.0 \text{ m} = 22.97 \text{ ft.} \\ & & A &= 43,560 \text{ ft}^2 \end{aligned}$$

PIHR > Pwf . . . no slope change has occurred

PERMEABILITY:

$$\begin{aligned} K &= \frac{162.6 \text{ qmB}}{mh} = \frac{162.6(43.45)(19.569)(1.024)}{0.145(22.97)} \\ &= 42,505.968 \text{ md} \end{aligned}$$

Pressure Comparison :

Pressure Survey : July, 1981 Pextrapolated 6775 Kpag

DST Analysis : May, 1980 Pextrapolated 6565 Kpag

Because of the highly fractured nature of the formation, flow is not radial and may not be laminar. Darcy equations used with Horner Plot analysis yield only "relative" permeability value, indicative only that permeability is very high.

As the well was flowing to surface, pressure build-up rate was limited to the compressibility of the fluid. Running the bomb into a full wellbore for a pressure test achieved a gradient that was almost identical to that of the gradient test. The result is an extremely short build-up time that is not accurately analyzed by conventional methods.

A review of the log  $\Delta T$  vs Log  $\Delta P$  graph shows a slope of  $\frac{1}{4}$ , indicative of a fractured formation. (SPEJ Sept. 1981).

DATA SHEET  
W. KIRKELLA 12-18

$T_p = 4932 \text{ L}$

$\frac{T_p + \Delta T}{\Delta T}$	$\Delta T \text{ (hrs)}$	P (Kpag)	$\Delta P \text{ (Kpag)}$
24,661.0	0.2	6761.1	0
9,865.0	0.5	6765.6	4.5
3,289.0	1.5	6766.5	5.4
1,410.0	3.5	6766.9	5.8
658.6	7.5	6770.6	9.5
319.2	15.5	6772.7	11.6
210.9	23.5	6773.9	12.8
157.6	31.5	6773.9	12.8
125.9	39.5	6774.3	13.2
104.8	47.5	6774.3	13.2
89.9	55.5	6774.3	13.2
78.7	63.5	6774.7	13.6
69.8	71.7	6775.1	14.0

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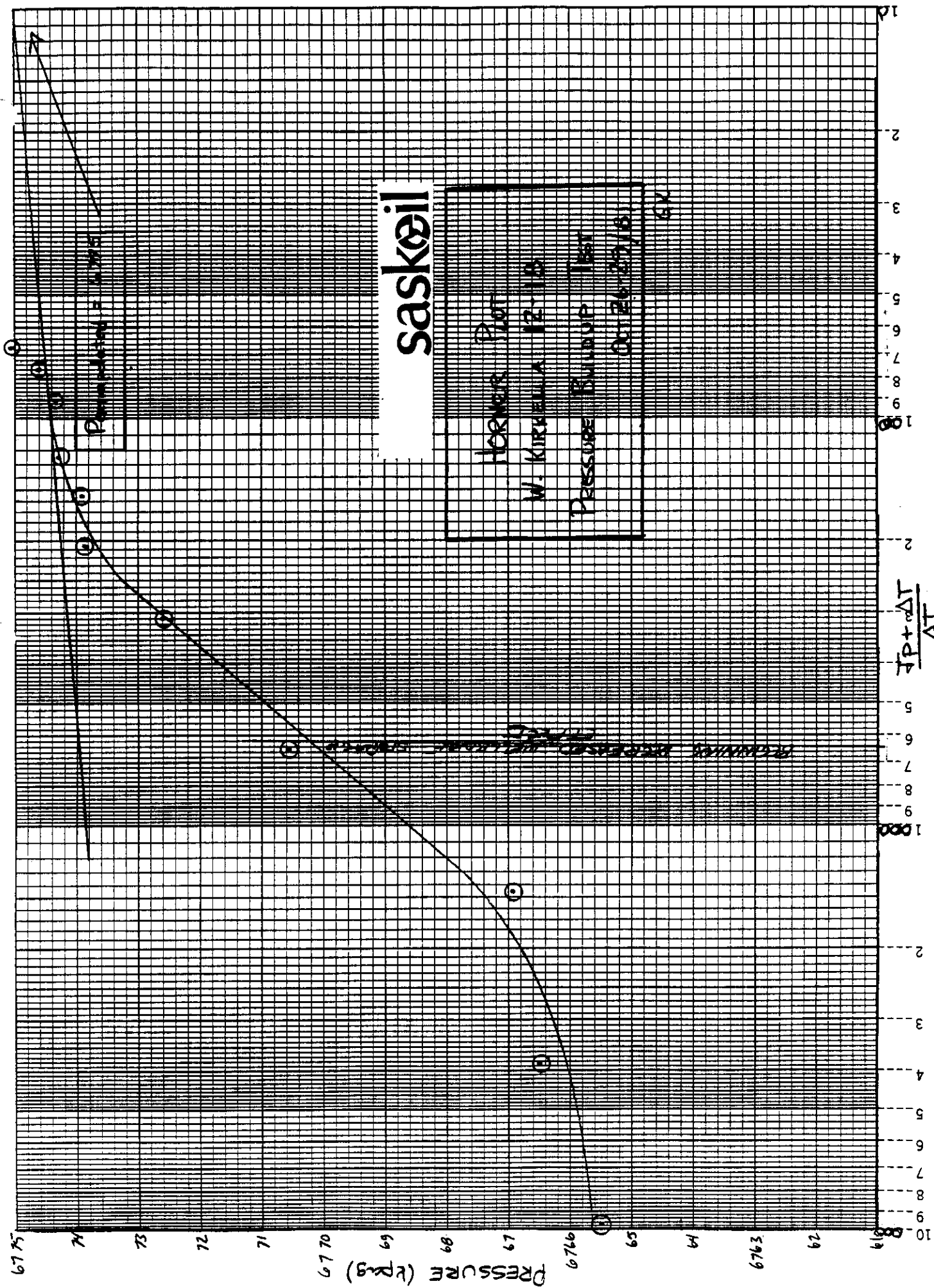
Horner Plot

W. KIRKELLA 12-118

PRESSURE BUILDUP TEST

00126-27/61

6X



# saskoel

$\Delta P (kPa_g)$  46 7402

K-Σ LOGARITHMIC 3 X 3 CYCLES  
KEUFFEL & ESSER CO. MADE IN U.S.A.

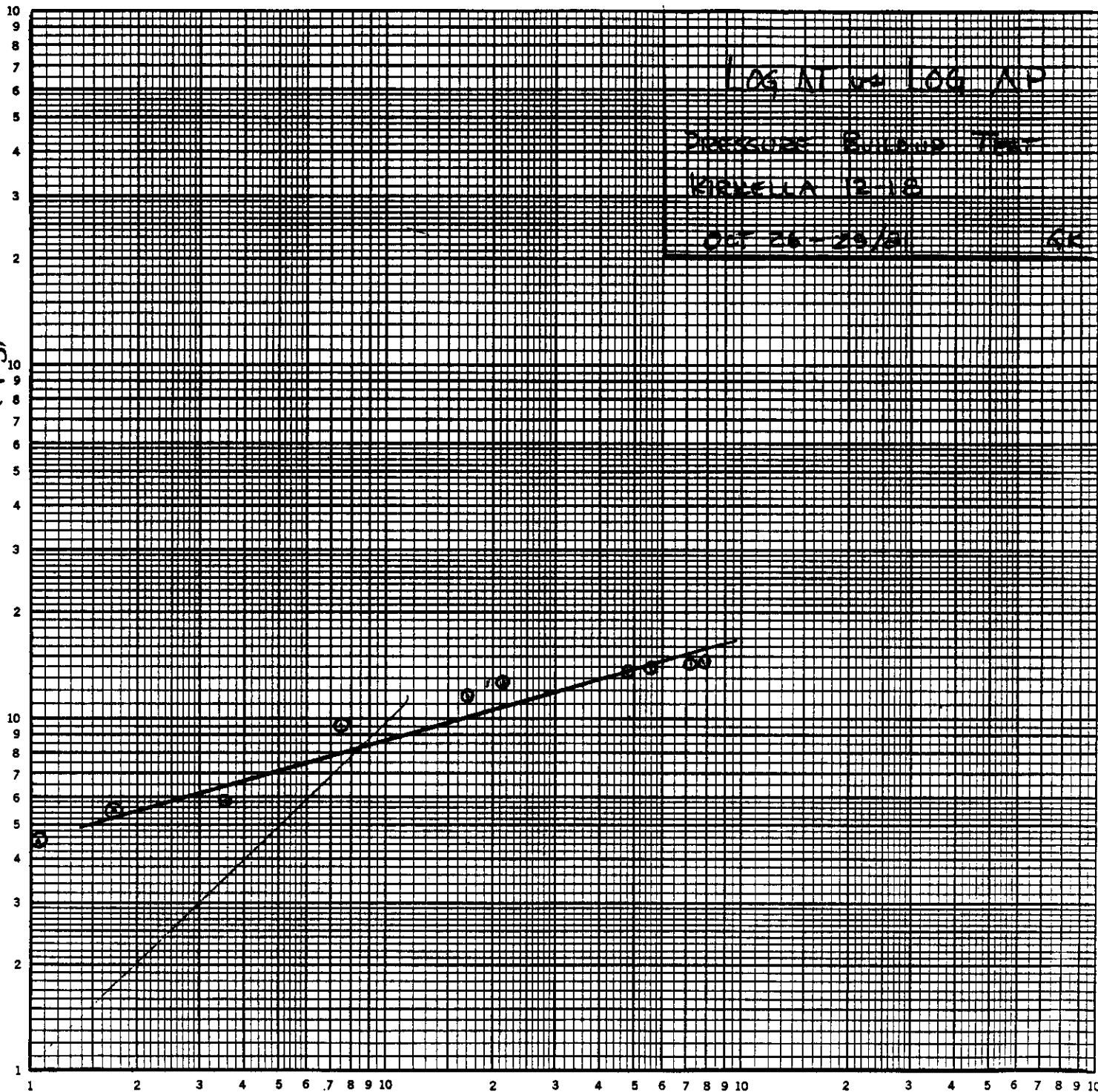
LOG NT vs LOG ΔP

Pressure Buildup Test

KIRKELLA 12-18

OCT 24 - 25/81

AK



$\Delta T (h)$

BUILDUP TEST

5-18-12-29



## PRESSURE BUILDUP TEST ANALYSIS

KIRKELLA 5-18

### DISCUSSION:

Although the Horner Plot exhibits radical shape, it should be noted that there is only a 3.4 psig (22kpag) variance in pressure data. As the well is a flowing well, the sandface pressure was realized almost instantaneously once the recorder had reached run depth. Because there is no buildup curve to analyze, the only fact for report is that permeability is high, average pressure at sandface is 6805 Kpag, and no depletion in pressure is realized when DST data is compared to this figure.

saskoel

HORNER PLOT  
KIRKELA 5-18  
PRESSURE BUILDUP TEST

OCTOBER

