CORE ANALYSIS REPORT
CARDINAL RIVER
BAIRD ~~BARD~~ #1
COWLEY COUNTY, KANSAS

15-035-24382

Prepared For:
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File Number: SL 9151

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Stim-Lab
A CORE LABORATORIES COMPANY

CANRDINAL RIVER
BARD #1 BAIRD
COWLEY COUNTY, KANSAS
SEC. 28, T34S-R3E

CORE ANALYSIS REPORT

INTRODUCTION

The Bard Baird # 1 well was cored using diamond coring equipment and drilling fluid to obtain a 4-inch diameter core from 2994.0 to 3054.5 feet.

The core was transported from the well site to the STIM-LAB, Inc. facility in Duncan, Oklahoma for general core processing and preservation. The core was cleaned, examined and marked with red and black stripes. The red stripes are placed on the right side to indicate the top of the core. The core was marked at one foot intervals, labeled and placed in zip-lock bags.

Frank Schroeder with Cardinal River visited the Stim-Lab Inc facility and selected 28 samples for routine core analysis. A gamma log was run and 28 plugs were drilled. David Carman visited the Stim-Lab, Inc. facility chose 8 additional plugs for routine core analysis, 3 plugs for X-Ray Diffraction (XRD) and 3 plugs for flow studies. The flow studies data and report are being prepared by the Core Flow department and will be sent under separate report. A porosity vs. permeability plot is provided for statistical evaluation at the end of this report.

SAMPLE PREPARATION

PLUG PREPARATION: The core plugs were drilled with a 1" diameter diamond tipped core barrel cooled with water. The plugs were trimmed using a saw equipped with diamond blades. The plugs were faced with a diamond facing tool to provide right circular cylinders.

SAMPLE CLEANING: The samples were extracted of hydrocarbons in a soxhlet extractor. Toluene & Methanol was used as the refluxing solvent. Extraction was continued until the returning solvent was clear.

SAMPLE DRYING: The samples were dried in a convection oven at 240° F for 24 hours.

FLUID EXTRACTIONS AND SATURATIONS

Fluid removal and saturations were determined using a Dean Stark/gas solvent extraction method.

DEAN STARK FLUID SATURATIONS: Each plug sample was weighed, placed in a glass tare, and extracted of hydrocarbons and water using a Dean Stark apparatus. The Dean Stark method uses toluene as the refluxing solvent. Each sample was suspended over boiling toluene at approximately 240 °F. Toluene vapor, along with water vapor from each sample, was cooled in a distillation tower and collected in a receiving tube where the water separated from the toluene. The extracted oil remained in the toluene. Saturations were calculated by using the measured water volume and a gravimetrically derived oil volume. An oil density of 0.89

POROSITY AND PERMEABILITY MEASUREMENT WITH CMS-300

Conventional core samples are analyzed using the CMS-300 automated core measurement system that incorporates a porosimeter and permeameter into one instrument. The CMS-300 system performs computer-controlled, unsteady state, pressure-transient measurements of reservoir rock pore volumes, porosity, Klinkenberg permeability, Forchheimer inertial factor and Klinkenberg slip factor at up to eight specified confining pressures between 500 psi and 10,000 psi. This allows measurements to be made at overburden pressures more representative of reservoir conditions. Helium is the test gas used.

POROSITY: Porosity is defined as the ratio of the pore volume to the bulk volume of material.

$$\text{Porosity} = \frac{\text{Pore Volume (Volume Of Helium Injected Into the Pore Space by the CMS)}}{\text{Bulk Volume (Volume Of The Plug As Determined By A Fowler Ultra-Call Mark III Digital Caliper)}}$$

This equation corrects for bulk volume reduction as overburden pressure is applied.

PERMEABILITY: Permeability is a measure of the ability of a porous material to transmit fluid.

Kinf = Klinkenberg corrected permeability. Equivalent, non-reactive, liquid permeability determined by the CMS at up to eight designated, net-overburden, confining stresses. This is an improved flow capacity indicator since gas slippage effects present at low laboratory pore pressure (and not at reservoir conditions) have been eliminated.

Kair = A calculated air permeability approximating historical core analysis permeability data. Kair is an optimistic value. Low pressures in historical laboratory measurements result in gas slippage not present at reservoir conditions and create artificially high permeability values.

GRAIN DENSITY: Calculated grain densities were obtained utilizing bulk volume and pore volume measurements and clean, dry sample weights. Grain densities were checked against lithology standards.

LITHOLOGY DESCRIPTION: Samples are described using a Nikon binocular microscope and macroscopic examination. Rock type, grain size, cements, structures and other physical observations are noted. The first word in the description column of the core analysis report describes the rock type. See the included list of abbreviations.

X-RAY DIFFRACTION ANALYSIS

X-ray diffraction analysis (XRD) provides excellent qualitative mineral identification and semi-quantitative compositions by weight of the crystalline components of the rock samples. A complete procedure requires separate analysis of the "bulk" sample and the "clay" fraction. A table of compositions determined by XRD is presented in the report.

The representative samples selected for "bulk" analysis are first cleaned of surface contamination and ground until all of the material passes through a 200-mesh screen. Next, the sample is ground in acetone to produce a uniform powder of 10 to 50 micron particles. The powdered rock is lightly packed in a sample holder and scanned from 2 to 45 degrees 2-theta by step scanning 0.05 degrees 2-theta for 5 seconds. The counts at each step are directly collected by and stored in the computer for later analysis.

Analysis of the clay fraction begins by disaggregation of fine-grained material in water with ultrasonication. The suspended material is centrifuged to separate the particles by size. Particles less than 5 microns in size are filtered out of suspension. The filtered clays are transferred to a glass slide and scanned from 2 to 40 degrees 2-theta by step scanning as above. If swelling clays appear to be present, they are confirmed by saturating the clays with ethylene glycol vapor. The slide is then rescanned.

STIM-LAB, Inc.

Company: Cardinal River
Well: Bard #1
Location: Cowley County, Kansas
SEC. 28, T34S-R3E

Date: 1/19/2011
Files: SL 9151
Analyst(s): DM

STIM-LAB
CMS-300 CORE ANALYSIS DATA

Sample Number	Depth (ft)	Net Confining Stress (psig)	Porosity (%)	Permeability Kair (mD)	Permeability Klinkenberg (mD)	Beta ft(-1)	Alpha microns	Saturation Oil (% Pore Volume)	Saturation Water (% Pore Volume)	Grain Density g/cm3	Lithology
1	3001.5	940	14.9	0.372	0.224	1.71E+11	1.20E+02	11.0	59.3	2.71	Sd, gry, f-vf gr, 70% yel flu
2	3002.5	940	13.7	0.255	0.150	9.57E+11	4.50E+02	9.0	68.3	2.72	Sd, gry, f-vf gr, 60% yel flu
3	3003.5	940	10.7	0.089	0.044	2.42E+13	3.27E+03	4.4	81.6	2.72	Sd, gry, f-vf gr, tr% yel flu
4	3005.5	940	14.9	0.869	0.622	2.12E+11	4.18E+02	10.9	52.5	2.72	Sd, gry f gr, 90% yel flu
5	3006.5	940	15.0	1.58	1.22	5.34E+10	2.08E+02	10.8	50.3	2.71	Sd, gry f gr, 100% yel flu
6	3007.5	940	10.0	0.089	0.052	9.48E+12	1.54E+03	10.7	63.5	2.75	Sd, gry f gr, 30% yel flu
7	3008.5	940	7.4	0.016	0.008	6.55E+15	1.71E+05	11.2	68.3	2.78	Sd, gry f gr, 20% yel flu
8	3009.5	940	12.2	0.120	0.064	8.71E+12	1.73E+03	3.9	73.4	2.76	Sd, gry f gr, tr% yel flu
9	3010.5	940	14.3	0.858	0.623	1.73E+11	3.42E+02	12.8	54.2	2.72	Sd, gry f gr, 90% yel flu
10	3011.5	940	14.6	1.52	1.18	5.32E+10	2.01E+02	9.8	51.9	2.70	Sd, gry f gr, 90% yel flu
11	3012.7	940	11.2	0.898	0.721	1.42E+11	3.26E+02	14.1	54.3	2.75	Sd, gry f gr, 90% yel flu
12	3013.5	940	11.5	0.177	0.100	4.56E+11	1.42E+02	1.3	76.7	2.73	Sd, gry, f-vf gr, tr% yel flu
13	3014.5	940	14.3	1.75	1.36	3.64E+10	1.58E+02	13.0	53.7	2.72	Sd, gry f gr, 90% yel flu
14	3015.5	940	15.1	3.90	3.23	8.35E+09	8.66E+01	10.8	53.9	2.71	Sd, gry f gr, 100% yel flu
15	3016.5	940	14.2	2.84	2.35	1.53E+10	1.15E+02	12.2	55.7	2.72	Sd, gry f gr, 80% yel flu
16	3017.5	940	12.7	0.571	0.396	2.35E+11	2.94E+02	10.6	60.5	2.70	Sd, gry f gr, 60% yel flu
17	3018.5	940	14.6	2.18	1.73	2.74E+10	1.51E+02	10.0	53.6	2.69	Sd, gry f gr, 100% yel flu
18	3019.5	940	14.0	2.83	2.35	1.91E+10	1.44E+02	10.0	54.9	2.68	Sd, gry f gr, 50% yel flu

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STIM-LAB
CMS-300 CORE ANALYSIS DATA

Sample Number	Depth (ft)	Net Confining Stress (psig)	Porosity (%)	Permeability Kair (mD)	Permeability Klinkenberg (mD)	Beta ft(-1)	Alpha microns	Saturation Oil (% Pore Volume)	Saturation Water (% Pore Volume)	Grain Density g/cm3	Lithology
19	3020.5	940	12.3	0.556	0.400	1.20E+11	1.52E+02	9.7	61.7	2.71	Sd, gry f gr, 60% yel flu
20	3021.5	940	15.2	3.73	3.07	6.95E+09	6.84E+01	10.4	49.0	2.69	Sd, gry f gr, 100% yel flu
21	3022.3	940	15.2	4.43	3.70	9.05E+09	1.08E+02	13.2	50.6	2.68	Sd, gry f gr, 100% yel flu
22	3023.5	940	12.9	0.413	0.267	2.74E+11	2.31E+02	4.9	75.1	2.69	Sd, gry f-vf gr, tr% yel flu
23	3024.5	940	14.9	2.75	2.20	1.70E+10	1.19E+02	10.8	56.5	2.68	Sd, gry f gr, 80% yel flu
24	3025.4	940	13.4	0.937	0.679	1.90E+11	4.09E+02	7.1	65.1	2.69	Sd, gry f gr, 30% yel flu
25	3026.5	940	10.9	0.474	0.345	7.27E+10	7.95E+01	5.7	66.5	2.72	Sd, gry f gr, 40% yel flu
26	3027.5	940	13.6	0.840	0.628	1.76E+11	3.51E+02	6.8	67.3	2.71	Sd, gry f gr, 20% yel flu
27	3028.5	940	15.3	7.46	6.51	2.53E+09	5.30E+01	12.3	50.9	2.68	Sd, gry f gr, 100% yel flu
28	3029.5	940	15.1	3.67	3.01	8.68E+09	8.39E+01	11.2	51.0	2.69	Sd, gry f gr, 100% yel flu
29	3030.8	950	15.8	3.77	3.06	8.51E+09	8.36E+01	9.0	57.2	2.70	Sd, gry f gr, 90% yel flu
30	3031.4	950	15.0	1.91	1.48	3.07E+10	1.45E+02	0.2	74.2	2.69	Sd, gry, f-vf gr, 10% yel flu
31	3032.3	950	16.0	4.93	4.09	4.98E+09	6.55E+01	7.9	54.7	2.69	Sd, gry, f-vf gr, 100% yel flu
32	3033.4	950	14.4	1.30	0.977	7.98E+10	2.49E+02	5.2	65.4	2.71	Sd, gry, f-vf gr, 40% yel flu
33	3034.5	950	17.3	11.1	9.68	1.31E+09	4.09E+01	10.9	54.9	2.69	Sd, gry, f gr, 100% yel flu
33V	3034.8	950	17.2	8.69	7.54	1.81E+09	4.40E+01	8.8	55.0	2.69	Sd, gry, f gr, 90% yel flu
34	3035.0	950	16.9	15.3	13.7	8.14E+08	3.58E+01	11.0	53.5	2.69	Sd, gry, f gr, 100% yel flu
35	3035.6	950	16.2	6.36	5.33	2.43E+09	4.17E+01	9.4	53.7	2.70	Sd, gry, f gr, 100% yel flu

Core Lab

STIM-LAB, Inc.

Company: Cardinal River
Well: Bard #1
Location: Cowley County, Kansas
SEC. 28, T34S-R3E

Date: 1/19/2011
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Mineralogical Data by X-Ray Diffraction
Cardinal River
Bard #1
SEC. 28, T34S-R3E Cowley County, Kansas

Depth (ft.)	Quartz %	Plagioclase %	K-feldspar %	Ankerite %	Siderite %	Apatite %	Total Clays %	Illite %	Chlorite %
3012	52	11	1	19	trace	trace	17	9	8
3018	61	17	2	5	trace	trace	15	8	7
3034	64	16	3	3	trace	trace	14	8	6

STANDARD ABBREVIATIONS FOR LITHOLOGIC DESCRIPTIONS

Word	Abbreviation
abundant	abd
acicular	acic
altered	alt
alternating	altg
angular	ang
anhydrite (-ic)	Anhy, anhy
aragonite	Arag
argillaceous	arg
arkose (-ic)	Ark, ark
asphalt (ic)	Asph, asph
authigenic	authg
band (-ed)	Bnd, bnd
bed (-ed)	Bd, bd
bedding	Bdg
bentonite (-ic)	Bent, bent
bitument (-inous)	Bit, bit
black (-ish)	blk, blksh
breccia (-ted)	Brec, brec
bright	brt
brown	brn
burrow (-ed)	Bur, bur
calcite (-ic)	Calc, calctc
calcareous	calc
carbonaceous	carb
cavern (-ous)	Cav, cav
cement (-ed, -ing)	Cmt, cmt
chalcedony (-ic)	Chal, chal
chalk (-y)	Chk, chky
chert (-y)	Cht, cht
chlorite (-ic)	Chlor, chlor
clastic	clas
clay (-ey)	Cl, cl
claystone	Clst
coarse	crs
conglomerate (-ic)	Cgl, cgl
consolidated	consol
contamination (-ed)	Contam, contam
contorted	cntrt
core	c, ¢
crinoid (-al)	Crin, crinal
cross	x
crystal (-line)	Xl, xln
cuttings	Ctgs
dark (-er)	dk, dkr
debris	Deb
dense	dns
detrital	detr
disseminated	dissem
dolomite (-ic)	Dol, dol
dominant (-ly)	dom
earthy	ea
evaporite (-itic)	Evap, evap
excellent	ex
faint	fnt
fair	fr
feldspar (-athic)	Fspr, fspr
ferruginous	ferr
fibrous	fibr
fine (-ly)	f, fnly
fissile	fis
fluorescence (-ent)	Fluor, fluor
formation	Fm
fossil (-ferous)	Foss, foss
fracture (-d)	Frac, frac
fragment (-al)	Frag, frag
Friable	fri
Frosted	fros
glauconite (-itic)	Glauc, glauc
good	gd
grading	grad
grain (-s, -ed)	Gr, gr
granite	Grt
granule (-ar)	Gran, gran
gravel	Grv
gray, grey (-ish)	gy, grysh
green (-ish)	gn, gnsh
gypsum (-iferous)	Gyp, gyp
halite (iferous)	Hal, hal
hematite (-ic)	Hem, hem
heterogeneous	hetr
homogeneous	hom
horizontal	hor
hydrocarbon	Hydc
insoluble	insl
intergranular	intgran
irregular (-ly)	irr
lamina (-tions, -ated)	Lam, lam
lens, lenticular	Len, lent
light	lt
limestone	Ls
limy	lmy
lithic	lit
lithology (-ic)	Lith, lith
local	loc
loose	lse
marble	Mbl
marl (-y)	Mrl, mrl
massive	mass
matrix	Mtrx
medium	m or med.
mica (-ceous)	Mic, mic
micrite (-ic)	Micr, micr
micropore (-osity)	Micropor, micropor
mineral (-ized)	Min, min
minor	mnr
moderate	mod
mold (-ic)	Mol, mol
mosaic	mos
mottled	mott
mud (-dy)	md, mdy
mudstone	Mdst
muscovite	Musc
nodules (-ar)	Nod, nod
no show	n/s
novaculite	Novac
no visible porosity	n.v.p.
occasional	occ
ooid (-al)	Oo, oo
oolite (-itic)	Ool, ool
orange (-ish)	Or, orsh
organic	Org
orthoclase	Orth
Oxidized	ox
Parting	Ptg
patch (-y)	Pch, pch
pebble (-ly)	Pbl, pbl
pellet (-al)	Pel, pel
permeability (-able)	Perm, k, perm
phosphate (-atic)	Phos, phos
pink (-ish)	pk, pkish
pin-point (porosity)	p.p.
pisolite, pisolitic	Pisol, pisol
plagioclase	Plag
platy	plty
porcelaneous	porcel
porosity, porous	Por, Φ, por
possible (-ly)	poss
probable (-ly)	prob
pyrite (-itized, -itic)	Pyr, pyr
quartz (-ose)	Qtz, qtz
recovery (-ered)	Rec, rec
residue (-ual)	Res, res
rhomb (-ic)	Rhb, rhb
rubble (-bly)	Rbl, rbl
salt and pepper	s & p
sand (-y)	Sd, sdy
sandstone	Sst
saturation (-ated)	Sat, satd
shale (-ly)	Sh, sh
siderite (itic)	Sid, sid
sidewall core	S.W.C.
silt (-y)	Slt, slty
siltstone	Sltst
skeletal	skel
slight (-ly)	sli, slily
sorted (-ing	srt, srtg
spar (-ry)	Spr, spr
sparse (-ly)	sps, spsly
Spicule (-ar)	Spic, spic
stain (-ed, -ing)	Stn, stn
streak (-ed)	Strk, strk
stringer	strgr
stylolite (-itic)	Styl, styl
sucrosic	suc
syntaxial	syn
thin section	T.S.
trace	Tr
Tripoli (-itic)	Trip, trip
unconsolidated	uncons
vertical	vert
very	v
very poor sample	V.P.S.
vug (-gy)	Vug, vug
white	wh
yellow (-ish)	yel, yelsh

STIM-LAB, Inc.

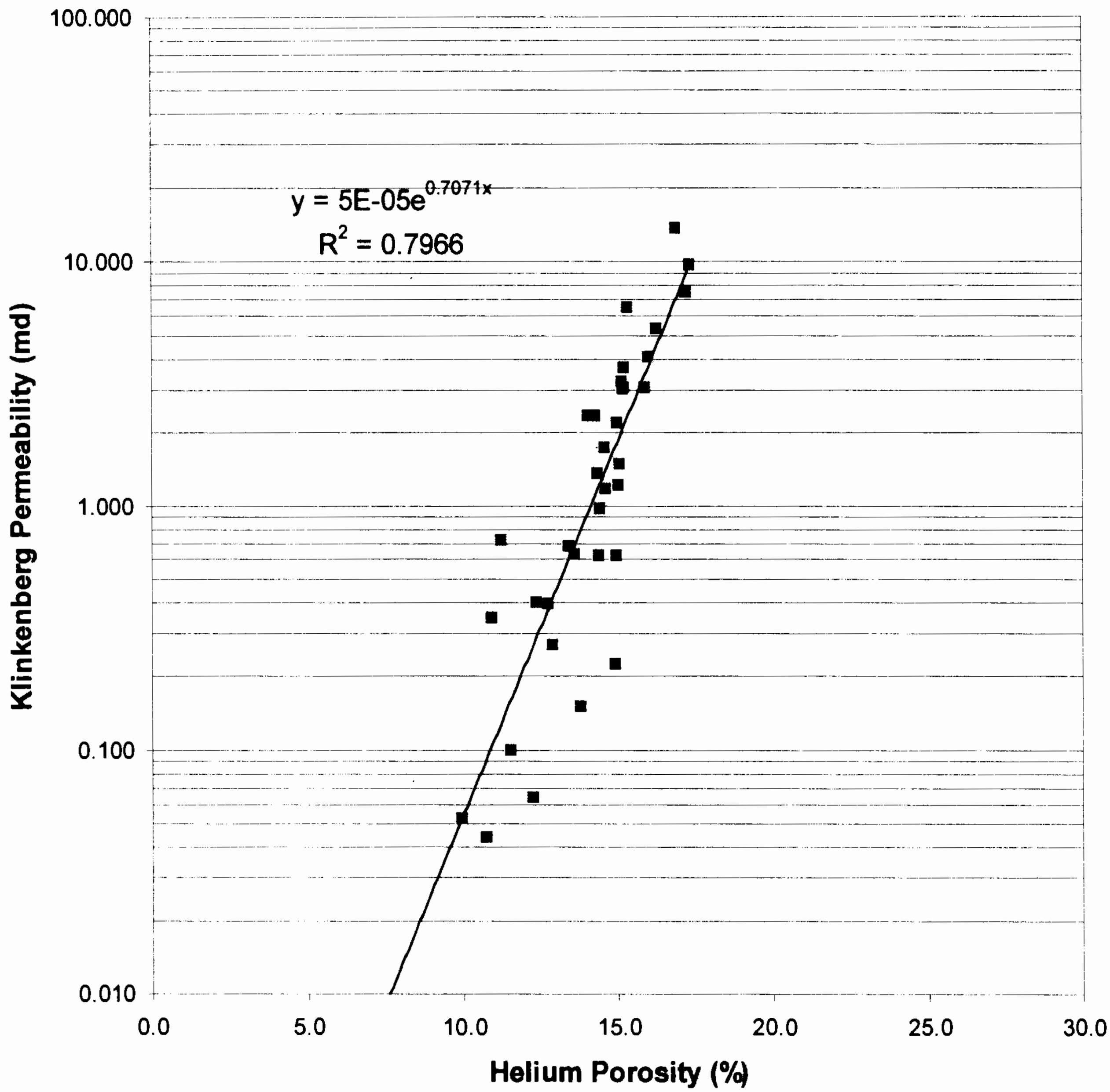
STIM-LAB Division of Core Laboratories

Company:	Cardinal River	Date:	1/19/2011
Well:	Bard #1	File No.:	SL 9151
Location:	Cowley County, Kansas		
	SEC. 28, T34S-R3E		

SUMMARY OF CORE DATA

ZONE AND CUTOFF DATA		CHARACTERISTICS REMAINING AFTER CUTOFFS	
ZONE:		**OB Pressure:**	940
Identification			
Top Depth	3001.5 ft		
Bottom Depth	3035.6 ft		
Number of Samples	36 ft	**Kinf:**	
Thickness Represented	34.1 ft	Maximum	13.6 md
		Minimum	0.008 md
		Arithmetic Average	2.30 md
POROSITY:		Harmonic Average	0.160 md
Arithmetic Average	14.0 %	Geometric Average	0.898 md
Minimum	7.4 %	Standard Dev. (Geom), ±	K•10 ±3.00 md
Maximum	17.3 %		
Standard Deviation	±x2.12 %		
		Kair	
GRAIN DENSITY:		Maximum	15.3 md
Arithmetic Average	2.71 gm/cc	Minimum	0.016 md
Minimum	2.68 gm/cc	Arithmetic Average	2.76 md
Maximum	2.78 gm/cc	Harmonic Average	0.284 md
Standard Deviation	±.022 gm/cc	Geometric Average	1.22 md
		Standard Dev. (Geom), ±	K•10 ±3.39 md

Cardinal River
Bard #1
Cowley County, Kansas
Sec. 28, T34S-R3E
Permeability vs. Porosity Crossplot
3001.5 to 3035.6 ft



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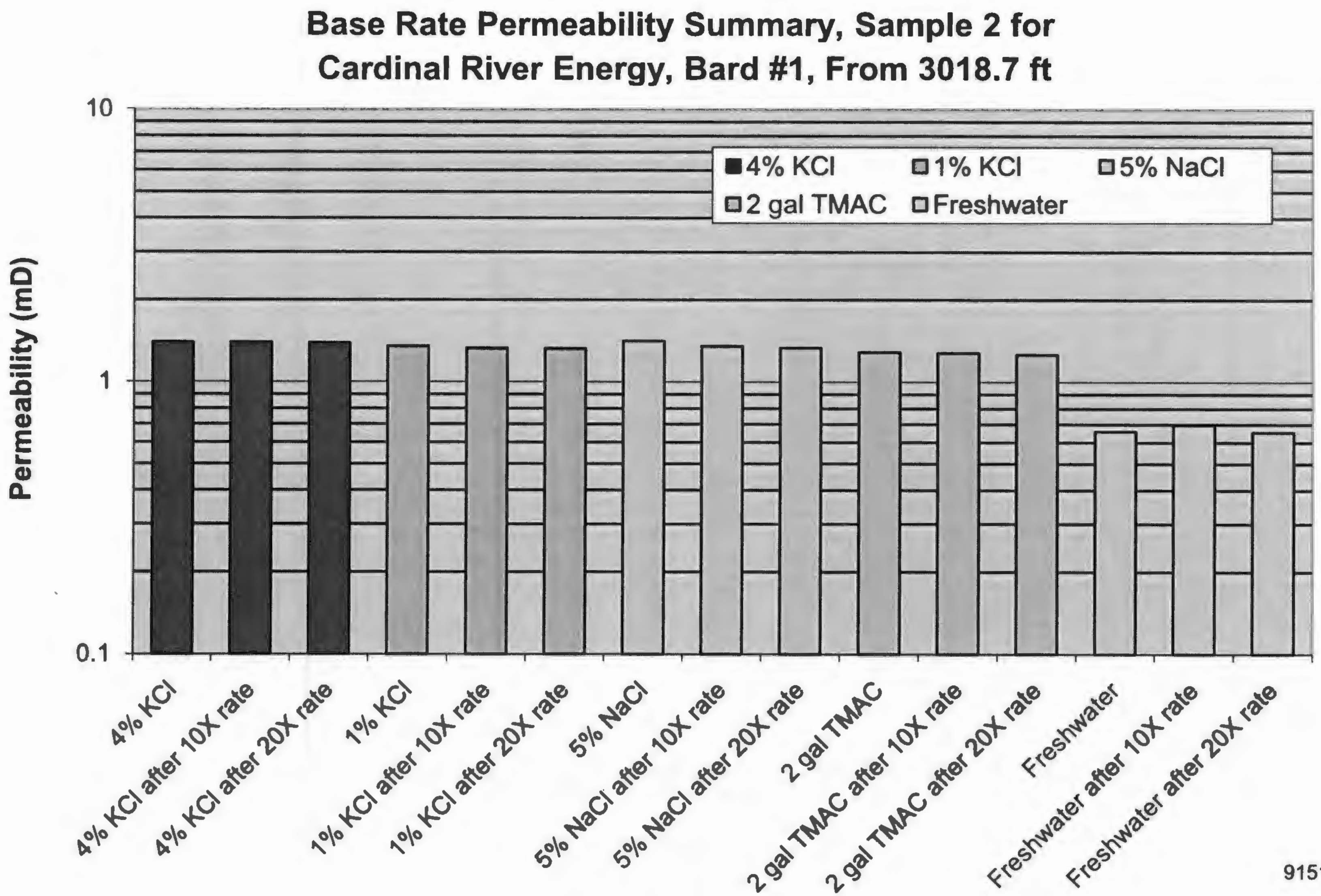
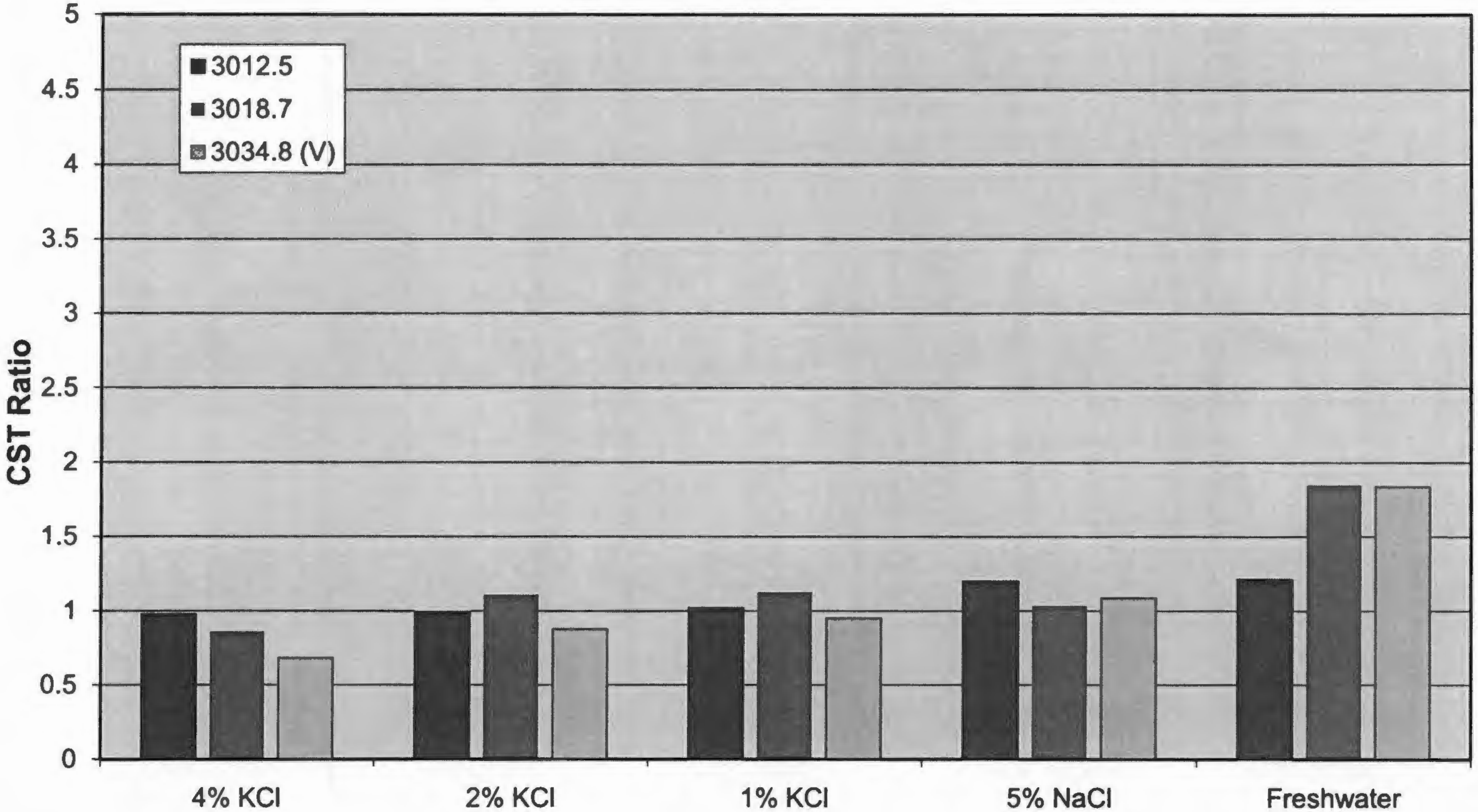
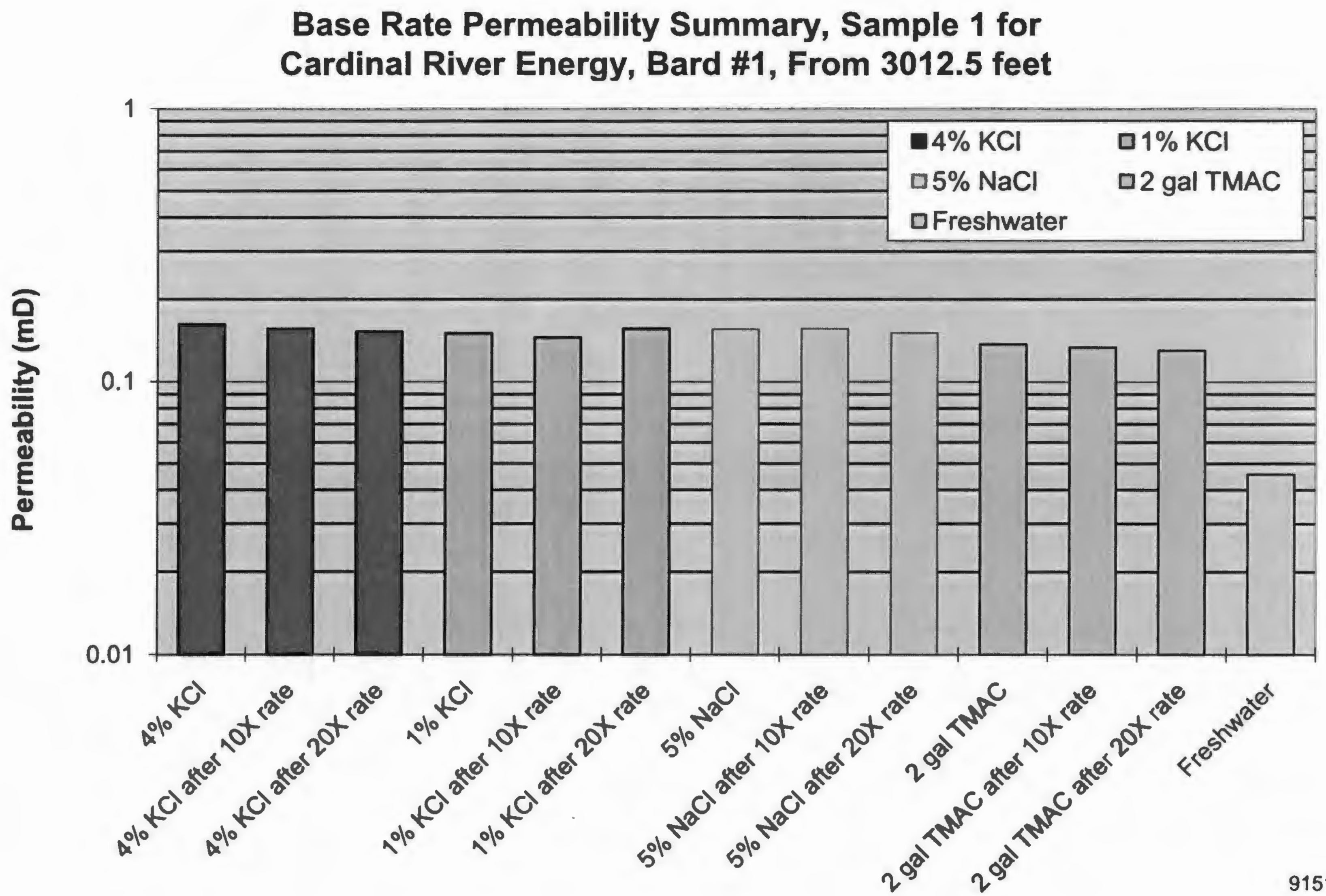

Base Rate Permeability Summary, Sample 2 for
Cardinal River Energy, Bard #1, From 3018.7 ft
Permeability (mD)
10
1
0.1
4% KCl
1% KCl
5% NaCl
2 gal TMAC
Freshwater
4% KCl
4% KCl after 10X rate
4% KCl after 20X rate
1% KCl
1% KCl after 10X rate
1% KCl after 20X rate
5% NaCl
5% NaCl after 10X rate
5% NaCl after 20X rate
2 gal TMAC
2 gal TMAC after 10X rate
2 gal TMAC after 20X rate
Freshwater
Freshwater after 10X rate
Freshwater after 20X rate

9151T2

Figure 1
Relative Fluid Sensitivity by CST For Plug Samples From Bard No.1




Base Rate Permeability Summary, Sample 1 for
Cardinal River Energy, Bard #1, From 3012.5 feet
Permeability (mD)
1
0.1
0.01
4% KCl
1% KCl
5% NaCl
2 gal TMAC
Freshwater
4% KCl
4% KCl after 10X rate
4% KCl after 20X rate
1% KCl
1% KCl after 10X rate
1% KCl after 20X rate
5% NaCl
5% NaCl after 10X rate
5% NaCl after 20X rate
2 gal TMAC
2 gal TMAC after 10X rate
2 gal TMAC after 20X rate
Freshwater

9151T1