Core Lab
PETROLEUM SERVICES

CMS-300 CONVENTIONAL PLUG ANALYSIS

Ellora Energy

Carl 7D17-30-38
Little Bow Field
~~Stevens~~ Co., KS
Grant

17-30S-38W
SW SE NW NW
15-067-21688

CL File Number: DEN-090028

Date: 2nd June, 2009

Confidential
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Ellora Energy
Boulder, CO
303-444-8881

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Sample Number	Depth (ft)	Net Confining Stress (psig)	Porosity (%)	Permeability		b(air) psi	Beta ft(-1)	Alpha (microns)	Saturation		Grain Density (g/cm3)	Footnote
				Klinkenberg (md)	Kair (md)				Oil % Pore Volume	Water % Pore Volume		
20	5745.40	2450	12.25	124	203	8.96	4.52E+09	1.82E+03	6.47	7.63	2.717	
21	5746.50	2450	13.85	73.6	97.8	4.77	9.74E+09	2.32E+03	5.44	9.55	2.702	
22	5747.40	2450	12.33	104	130	3.58	3.02E+09	1.02E+03	7.91	7.57	2.695	
23	5748.20	2450	11.28	79.3	88.2	1.62	9.55E+09	2.46E+03	7.35	8.05	2.696	

Footnotes :

(1) : Denotes fractured or chipped sample. Permeability and/or porosity may be optimistic.

(2) : Sample permeability below the measurement range of CMS-300 equipment at indicated net confining stress (NCS). Data unavailable.

(3) : Denotes very short sample, porosity may be optimistic due to lack of conformation of boot material to plug surface.

(4) : Sample contains bitumen or other solid hydrocarbon residue.

(5) : Denotes sample unsuitable for measurement at stress. Porosity determined using Archimedes bulk volume at ambient conditions.

Permeability greater than 0.1 mD measured using helium gas. Permeability less than 0.1 mD measured using nitrogen gas. All b values converted to b (air)

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APPENDIX A: EXPLANATION OF CMS-300 TERMS "b", "Beta, and "Alpha"

K_∞	=	Equivalent non-reactive liquid permeability, corrected for gas slippage, mD
K_{air}	=	Permeability to Air, calculated using K_∞ and b, mD
b	=	Klinkenberg slip factor, psi
β (Beta)	=	Forcheimer inertial resistance factor, ft^{-1}
α (Alpha)	=	A factor equal to the product of Beta and K_∞. This factor is employed in determining the pore level heterogeneity index, H_i.
H_i	=	$\log_{10}(\alpha\phi/RQI)$ α, microns = $3.238E^{-9}\ \beta K_\infty$
Ø	=	Porosity, fraction
RQI	=	Reservoir Quality Index, microns
RQI	=	$0.0314(K/\phi)^{0.5}$

For further information please refer to:

Jones, S.C.: "Two-Point Determination of Permeability and PV vs. Net Confining Stress" SPE Formation Evaluation (March 1988) 235-241.

Jones S.C.: "A Rapid Accurate Unsteady-State Klinkenberg Permeameter," Soc. Pet. Eng. J. (Oct. 1972) 383-397.

Jones, S.C.: "Using the Inertial Coefficient, β, To Characterize Heterogeneity in Reservoir Rock: SPE 16949 (September 1987).

Amaefule, J.O.; Kersey, D.G.; Marschall, D.M.; Powell, J.D.; Valencia, L.E.; Keelan, D.K.: "Reservoir Description: A Practical Synergistic Engineering and Geological Approach Based on Analysis of Core Data,: SPE Technical Conference (Oct. 1988) SPE 18167.

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CMS-300 CONVENTIONAL PLUG ANALYSIS PROTOCOL

Sample Preparation
1.0" diameter plugs were drilled with liquid nitrogen and trimmed into right cylinders with a diamond-blade trim saw.
The samples were encapsulated in plastic wrap and aluminium foil. All sample trims were archived.

Core Extraction
Plugs selected for routine core analysis were placed in Dean Stark equipment using toluene, followed by Soxhlet extraction in methanol

Sample Drying
Samples were oven dried at 240° F to weight equilibrium (+/- 0.001 g).

Porosity
Porosity was determined using Boyle's Law technique by measuring grain volume at ambient conditions & pore volume at indicated net confining stresses (NCS)

Grain Density
Grain density values were calculated by direct measurement of grain volume and weight on dried plug samples.
Grain volume was measured by Boyle's Law technique.

Permeability
Permeability to air was measured on each sample using steady-state method at indicated NCS.

Fluid Saturations
Fluid saturations were determined by the Dean Stark technique using the following fluid properties:

Brine	1.032 g/cc (50000 ppm TDS)
Oil	0.879 g/cc (29.5° API)