

001 29 1984

Cons. Commission
Results of Shale Bulk Density Analysis

(cuttings)

Sample I.D.	Bulk Density (g/cc)	Sample I.D.	Bulk Density (g/cc)
EXXON Alaska State A-1			
12710-20	2.42		
12720-30	2.42		
12730-40	2.43		
12480-90	3.69*		

*Data considered unreliable

Results of Shale Bulk Density Analysis

Sample I.D.	Bulk Density (g/cc)	Sample I.D.	Bulk Density (g/cc)
EXXON Alaska State A-1		EXXON Alaska State F-1	
10216	2.49	12077	2.45
10230	2.49	12608	2.43
10241	2.48	12617	2.46
10264	2.50	12910	2.48
10267	2.50	12913	2.49
10646	2.52	EXXON Duck Island Unit No. 1	
10662	2.53	11538	2.62
10710	2.51	11542	2.62
10716	2.53	11548	2.53
10724	2.52	EXXON Pt. Thomson Unit No. 2	
10732	2.52	11621	2.59
12431	2.31	11721	2.54
12435	2.44	11843	2.57
12445	2.45	EXXON Pt. Thomson Unit No. 4	
12478	2.44	13569	2.49
12489	2.46	14798	2.49
12504	2.58	14811	2.50
12517	2.45	HUMBLE E. Mikkelsen Bay St. No. 1	
12523	2.48	12213	2.52
12556	2.44	12691	2.61
12558	2.48	MOBIL Beli No. 1	
12564	2.45	11231-32	2.59
12569	2.49	12224	2.56
12654	2.51	MOBIL Mikkelsen Bay St.# 13-9-19	
12657	2.54	11166-67	2.53
12665	2.44	11606-07	2.54
12675	2.48	11633-34	2.57
12691	2.47	11654-55	2.52
12704	2.45	11663-64	2.51
12714	2.39	11664-65	2.57
12723	2.42	MOBIL W. Staines St.# 18-9-23	
12727	2.43	7748-49	2.38
12747	2.38	7760-61	2.36
12748	2.35	10612-13	2.50
13232	2.64	10660-61	2.49
13958	2.73	11168-69	2.54
14178	2.73	11545-46	2.46
14187	2.71	11729-30	2.52
14197	2.70	12671-72	2.49
		SOHIO Challenge Isl. No. 1 Core#1	
		8243	2.32
		8244	2.11

SUBJECT: Shale Bulk Density Analyses

AUTHOR AND QUALITY CONTROL: Alan p. Byrnes

PROCEDURE: Shale core and cuttings samples were provided by Michael D. Wilson of Alaska Research Associates for Bulk Density analysis.

The samples were subsequently placed in a vacuum oven for one (1) week at a pressure of less than 10^{-2} torr and a temperature of 90°C. The samples were then cooled and were weighed on a torsion balance with an accuracy of 0.002 gms. Each sample was then placed in the mercury injection capillary apparatus.

Normally bulk volume is determined by displacement of mercury at injection pressures of 1 to 3 inches of mercury (immersion depth pressure). However small shale partings or fractures might not permit mercury entry while artificially adding to surface sample bulk volumes compared to subsurface volumes. To try and correct for this, samples were subjected to a vacuum of less than 10^{-3} torr and were then injected with mercury to atmospheric pressure (12.1 psia). This resulted in mercury intrusion into pores with a pore entry radius of approximately 10um (microns) and larger. The volume of mercury displaced by the sample (bulk volume) was measured to 0.005 cc. For many samples this procedure resulted in a negligible bulk volume difference than the immersion method would have measured.

Based on the average sample size, weights were measured with an accuracy of 0.02% and bulk volumes with an accuracy of 0.1-0.2%. Assuming these two variables are independent of each other then the overall accuracy of these measurements is approximately 0.2%.

DISCUSSION: Although the theoretical accuracy of these measurements is 0.2% because samples probably have changed from subsurface conditions the degree to which these sample densities represent in-situ bulk densities is uncertain. The degree to which the samples have "decompressed" and expanded since removal from in-situ stresses is indeterminable except by performing measurements under high confining stress.

Samples from the EXXON Alaska State A-1 well display significant changes in bulk density with depth. However, no major trends are discernable except between samples below 13958 and those above 12748. A brief comparison with Density Log -derived bulk densities indicates fair agreement at the shallowest and deepest intervals but there is no correlation for the interval 12431-12748.

In general, samples from shallower than 10,000 ft. exhibit bulk densities significantly less than samples from deeper than 10,000 ft.. Samples 12748, 12747, and 12431 are not consistent with this trend in EXXON Alaska State A-1. In addition, in the EXXON Alaska State A-1 well, samples below 13958 exhibit densities significantly greater than those shallower than 13958 though the EXXON Point Thomson Unit No. 4 does not exhibit this same trend.

It is uncertain without further testing what the effects of shale composition, sample retrieval and handling procedures, and storage history may have been upon laboratory measured bulk densities.

Company Alaska Research ASSOCS. Location ANWR Date 9/24/84