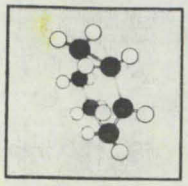

Hycal
ENERGY RESEARCH LABORATORIES LTD.

PARAMOUNT - CAMERON HILLS
DRILLING FLUID LEAKOFF STUDY

P211-1133-F-1

Prepared For

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Prepared By

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SUMMARY

At the request of Paramount Resources Ltd., Hycal Energy Research Laboratories Ltd. conducted a drilling fluid leakoff study. In this study, tests were conducted to evaluate fluid loss control capabilities and permeability impairment characteristics of proposed drilling fluids.

These tests were conducted using preserved core material from the 1407 to 1441 m interval of well I-74-60-10;117-15 in the Sulphur Point formation of the Cameron Hills field. The displacement tests were conducted at the reservoir temperature of 50°C with 8273 kPag of overburden pressure and no backpressure.

A total of three drilling fluid leakoff tests were initially specified using different muds. However, two of the preserved core samples were found to be impermeable to oil and could not be tested further. A single core plug was tested using the Gel Free drilling fluid. The major results of these tests are summarized in the following table:

Mud System	Gel Free	--	--
Core #	**5**	**3**	**4**
Initial Effective Permeability To Crude Oil (mD)	0.54	No Permeability	No Permeability
Mud Overbalance Pressure (kPa)	6000		
Linear Filtrate Penetration Depth (cm)	14.27		
Time To Seal Off (minutes)	*		
Leakoff Exposure Time (minutes)	240		
Regain Permeability To Crude Oil (mD)	0.21		
% Permeability Reduction After Mud Leakoff	60.8		
* Did not seal off			

RESULTS AND DISCUSSION

Core Preparation

Three of the six core plugs drilled from the preserved core material were mounted and tested for initial permeability to crude oil. Two of these three samples showed no initial permeability to oil and were abandoned from the test program. A summary of the disposition of the core plugs drilled for this test is provided in Table 1. The remaining core sample was used to perform the Gel Free drilling fluid leakoff.

Core #5 - Mud Leakoff Test With Gel Free Drilling Fluid and Microfines

Table 2 provides a summary of pertinent core and test parameters for core #5 from the 1423.0 m interval of Cameron Hills area well I-74-60-10;117-15. Gas permeability for the extracted core sample was 3.50 mD with a porosity of 9.5%.

Table 3 provides a permeability summary for the leakoff test conducted. The core was initially flooded with reservoir crude oil at a low rate and the injection rate was deliberately minimized to reduce any potential for fines mobilization. Initial permeability to oil at the base rate was 0.54 mD which is less than the initially measured air permeability.

This phenomena has been observed frequently at Hycal and may be related to the following factors:

1. Relative permeability effects associated with immobile connate water saturation.

2. Standard air permeability measurements are non-Klinkenberg slip corrected. Correction of air permeability data for sandface gas slippage can result in substantially lower effective gas permeabilities, particularly on very tight core material.

3. The application of reservoir pore pressure instead of nominal overburden pressure at which standard air permeabilities are normally determined can substantially reduce permeability due to physical compression of the flow channels. Increases in temperature have also been noted to have a reducing effect on permeability, although this effect is probably small at the low temperatures under consideration in this test.

4. Extracted and dried core material in general seems to exhibit higher air permeabilities (even if overburden pressure and temperature are held constant) than fluid saturated cores. This phenomenon is believed to be related to desiccation of the clays and other hydratable materials in the matrix caused by the extraction and drying process. Introduction of water into the matrix appears to rehydrate these materials causing a change in internal matrix flow geometry and a reduction in apparent permeability.

The mud leakoff test was conducted by circulating whole drilling mud across the simulated sandface of the core (in the reverse direction to the initial oilflood). The mud overbalance pressure into the core was maintained at a constant value of 6000 kPa during this process. Table 4 contains a summary of pertinent leakoff data for the test. Examination of these data indicates that the drilling mud exhibited moderate fluid loss without complete sealoff occurring after 240 minutes of overbalance exposure. A total invasion depth of 14.3 cm was measured during this period (assuming the pore space is 100% swept). Permeability and permeability reduction values for the core appear as Figure 2. The dynamic leakoff results of the leakoff test are summarized in Table 5 and have been plotted in Figures 3 and 4.

A regain permeability in the original flow direction with oil (to simulate production back from the reservoir after drilling) yielded an oil permeability of 0.21 mD which represents a 60.8% reduction from the initial baseline permeability value.