MEMORANDUM

SUBJECT: Time-Temperature Survey
Well 88-11 May 11 & 12, 1984
Fish Lake, Nevada (4816A)

May 30, 1984

TO: J. E. Deymonaz

cc: H. J. Olson
Wm. Dolan
Wim Lodder

FROM: H. D. Pilkington

The bit reached TD of 6147 feet at 0600 hours. A short trip was made and completed at 1200 hours and circulation with conditioned mud was started. Circulation ceased at 1600 hours. For comparative purposes a number of different time-temperature calculations are given below:

1. Clocktime	Event	t		Temp	TE(°F)
0400 May 11	Bit arrival	t_0			
1600	Circulation caused	t_s	4.00		
2010	Observation MRT	t_1	16.17	212.00	
0530 May 12	Observation MRT	t_2	24.50	264.00	351.5
0754	Observation Kuster	t_3	26.90	279.32	361.3
1354	Observation Kuster MRT	t_4	32.90	296.56	365.1

The above data set combines MRT readings from run 1 and 2 by Schlumberger and the first stable temperature measured by the Kuster tool and finally the MRT readings from the Kuster survey.

2.

Clocktime	Event	t	Temp °C	TE(°F)
0400 May 11	Bit arrival	t_0		
1600	Circulation ceased	t_s 4.00		
0754 May 12	Observation	t_1 26.90	137.4	
0825	Observation	t_2 27.42	138.44	188.0
0856	Observation	t_3 27.93	139.28	184.6
0927	Observation	t_4 28.44	140.21	185.0
0958	Observation	t_5 28.95	141.57	190.2
1029	Observation	t_6 29.46	142.30	190.5
1056	Observation	t_7 29.97	143.13	190.3
1127	Observation	t_8 30.48	143.96	190.1
1158	Observation	t_9 30.99	144.64	189.6
1229	Observation	t_{10} 31.50	145.42	189.3
1300	Observation	t_{11} 32.01	145.94	188.6
1331	Observation	t_{12} 32.52	146.36	187.6
1402	Observation	t_{13} 33.03	146.88	186.7

296.38°F

The data shown above (number 2) are from the Kuster survey run on May 12, 1984. Only one of every three temperature observations taken were used in the above calculation. The equilibrium temperature of 186.7°C (368.1°F) is higher than the equilibrium temperature calculated using the MRT data (365.1°F). The BHT is still rising after 33+ hours.

According to Brian Roux et al (1980), the use of the Horner method of estimating reservoir temperatures will lead to low estimates for short shut-in times. They propose a correction factor based upon t_{pd}, a dimensionless heat producing time and a range of Horner time $(t_p + \Delta t)/\Delta t$ values. For example 1 above we have:

Circulation time t_p = 4.00 hours
$t_{pD} = t_p$ (0.3/hr) average value for commonlithology
T_{DB} = 0.055 (from Figure 4 in Roux et al, 1980)

Δt (Shut-In Time)	$t_p + \Delta t/\Delta t$ (Horner Time)	t_w (Shut-In Temp. °F)
Δt_1 24.5 hours	4 + 24.5/24.5 = 1.163	264
Δt_2 26.9 hours	4 + 24.9/26.9 = 1.149	279
Δt_3 32.9 hours	4 + 32.9/32.9 = 1.122	297

T_f (formational temp) = Tw*s (Horner proj. temp) + m T_{DB} (t_{pd})

and

$Tw = Tw*s - m \log [(t_p + t)/ t]$

then

$297 = 365 - m \log (1.122)$
$m \log (1.122) = 68$
$m (0.115) = 68$
$m = 591.3$

and

$T_f = 365 + 591.30 (0.055) (1.2)$
$= 365 + 39.03$
$= 404.6^{o}F$ at 6140' depth in well

Thus we have equilibration temperatures of $365^{o}F$ and $368^{o}F$ based upon the Crosby method. The Roux et al method give a formation temperature of $405^{o}F$ at a depth of 6140 feet.

References

Crosby, G.W., 1977, Prediction of final temperature; 2nd annual workshop on Geothermal Reservoir Engineering, Stanford University, California.

Roux, B., Sanyal, S.K., and Brown, S.L., 1980. An improved approach to estimating true reservoir temperature from transient temperature data; 50th annual California Regional meeting Society of Petroleum Engineers.

HDP/vr

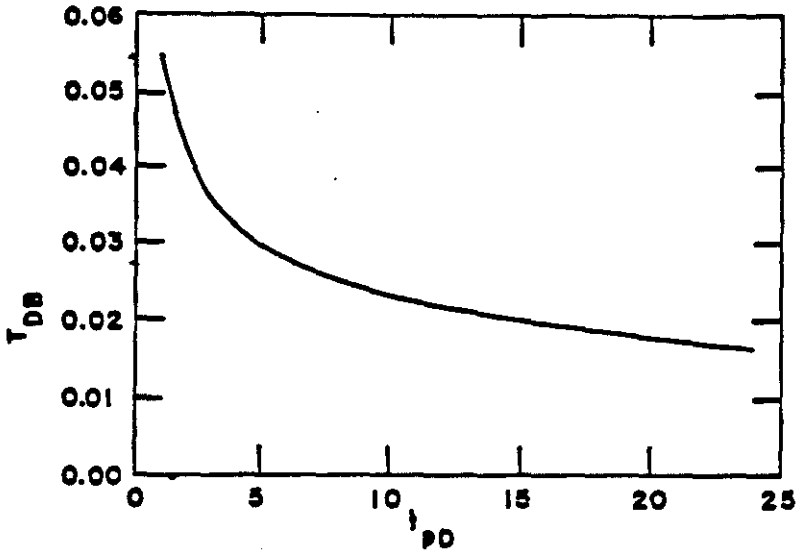

Fig. 4 - Correction curve ($t_{pD} \leq 25$).

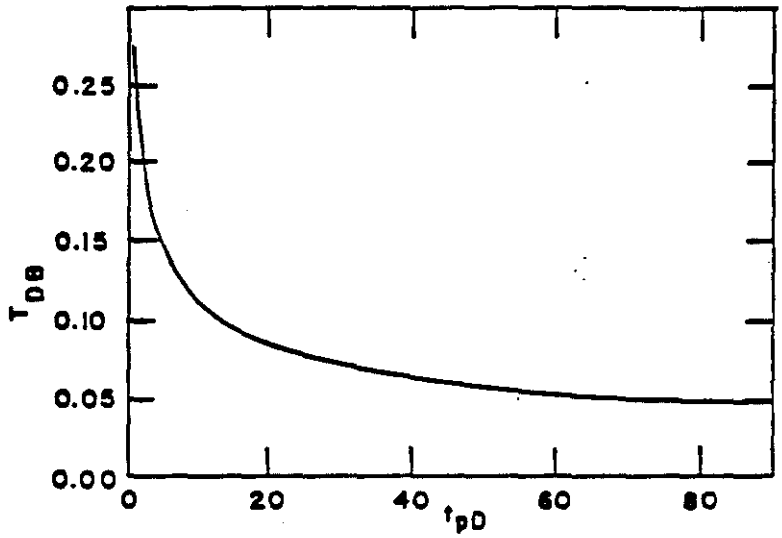

Fig. 5 - Correction curve ($t_{pD} \leq 80$).

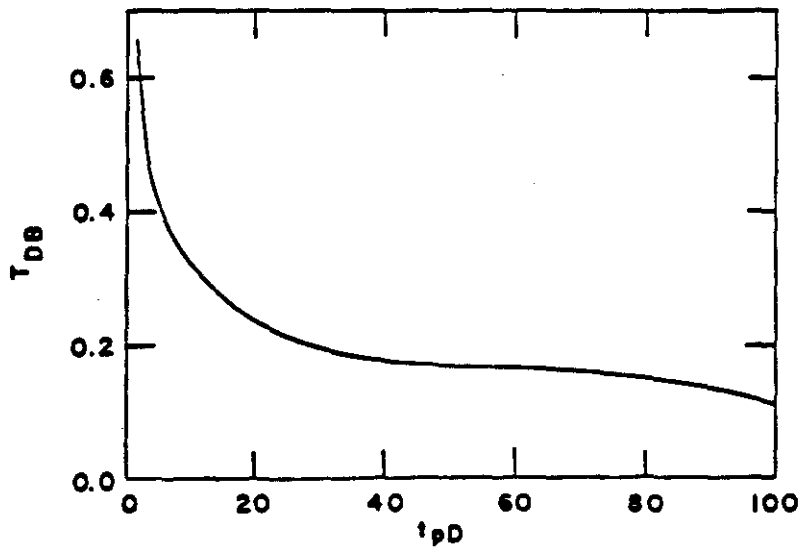

Fig. 6 - Correction curve ($t_{pD} \leq 100$).