

PR 66-37

AUSTRALIAN AQUITAINE PETROLEUM
PTY. LTD.

KULSHILL No. 1

VELOCITY SURVEY - SONIC CALIBRATION

JUNE, 1966

OP 2

OPEN FILE

AGENCE GENERALE DE GEOPHYSIQUE

PR 66-37

D.P. = GROUND LEVEL

Sect.

1

COORDINATES OF THE WELL LOCATION

LONGITUDE X: 129° 32' 33" E.

LATITUDE Y: 14° 21' 47" S.

Z KB: 281 ft

Z GL: 216 ft

DEPTH OF WELL: 14,406 ft

DEPTH OF CASING: 6,748 ft

MEASUREMENT RECORDED BY: X. 6526 (R. FEENAGHTY)

COMPAGNIE GENERALE DE GEOPHYSIQUE

D.P. = GROUND LEVEL

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LOCATION MAP

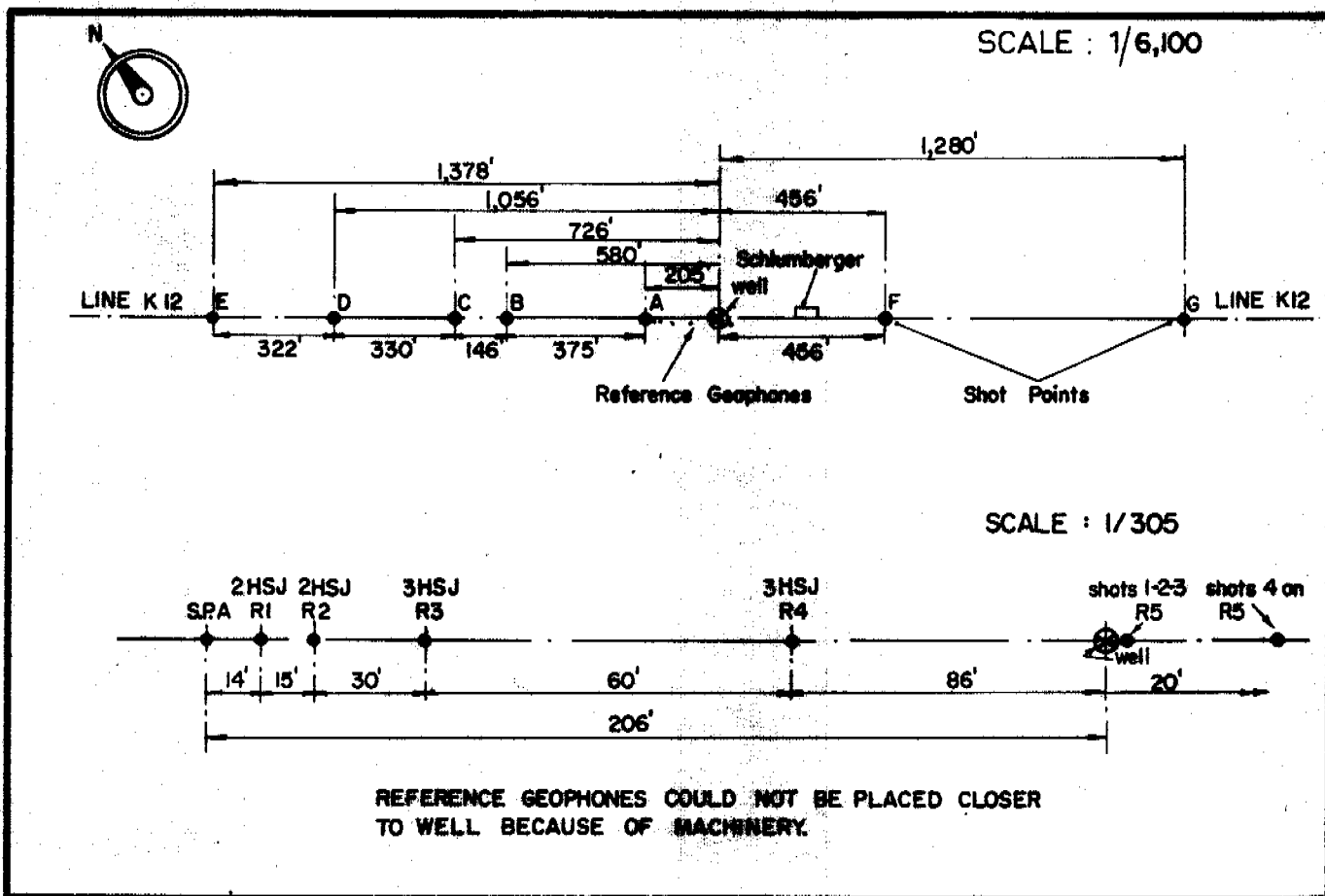
Tb. 2

Z KB :

WELL :

Z GL :

Shot point	Number	Distance	Z	ΔZ	Shot point	Number	Distance	Z	ΔZ
A		205 ft	216.6 ft	+0.4 ft					
B		580 ft	218.3	+2.3					
C		726	222.8	+6.8					
D		1056	227.3	+11.3					
E		1378	230.4	+14.4					
F		456	204.4	-11.6					
G		1280	200.5	-15.5					
Reference geophones :									
1		191 ft	216 ft						
2		176	216						
3		146	216						
4		86	216						
5		0 or 20	216						



(CONT.)

MEASUREMENTS

a) Recording conditions : 31st May : Gusty
 1st June : Fine - slight wind.

The survey was carried out by day.

All shots were on the surface or in craters from previous shots.

The Well-geophones insulation was checked before the survey and found good. After a few shots some leakages caused a high noise level on the records and the survey was suspended for several hours in order to check the circuits. When resuming the survey on the following day, the Gulf - well geophone appeared to be developing some trouble : the breaks were not pickable on the corresponding traces. So from shot 11 on, it was connected to traces 2 and 3 and the Hall Sears Junior Well geophones to traces 4, 5, 6, 7.

Back in Brisbane the Gulf geophone was checked and found severely damaged or if it had been dropped from a considerable height.

All breaks on the records are downwards for the Well geophones and the reference geophones as well.

The reference geophones were located in order to allow a determination of the velocity and thickness of the weathering zone.

b) Quality of the records :

Breaks on nearly all the records were pickable on the HS-J traces
The quality of the records was as following :

Shots 4 and 4 bis	:	NIL
3, 6, 9, 10, 20	:	Doubtful
1, 1 bis, 2, 2 bis, 8, 9, 12, 21	:	Poor
5, 7, 14, 15, 16, 17, 18, 19	:	Fair to Good

COMPUTATION AND CORRECTIONS

1) DATUM PLANE

Times and velocities are computed from the ground level of the Well (216 ft above m.s.l.).

2) WEATHERING ZONE (see Tb 6)

- Determined at shot point A (205 ft from the Well), using the reference geophones (traces 8 to 12 of the records). It was checked on records from the other shot points and found approximately the same.

Therefore it was assumed that the weathering zone had the same thickness at all shot points and the Well locations.

- The ground level was horizontal at the reference geophones locations.

- Results are as follows :

15 feet at 1,120 ft/ sec

74 feet at 3,570 ft/ sec

Horizontal velocity below the weathering : 7,320 ft/ sec.

3) CORRECTIONS

- The second case of Index of Corrections (Tb 5) was used for all shots.

- However, for the shots fired from craters up to 13 ft deep a complementary correction was made taking into account the depth of the crater at a velocity of 1,120 ft/ sec.

- The weathering zone correction is :

$$-\frac{15}{1.12} - \frac{74}{3.57} + \frac{89}{7.82} = -21.8 \text{ milliseconds}$$

It was not taken into account in the computation of corrected times.

- Elevation corrections to the ground level of the Well were calculated with a velocity of 7,320 ft/sec.

SONIC CALIBRATION

1) INTEGRATOR CALIBRATION COEFFICIENT Q

First run from 28 to 1,468 feet

After survey : 0.995

Second run from 1,416 to 5,399 feet

Before (?) survey : 1.003

Third run from 5,199 to 6,761 feet

Before survey : 1.002

After survey : 1.007

Fourth run from 6,761 to 10,812 feet

Before survey : 1.005

After survey : 1.016

INTERPRETATION of the RESULTS Tb.4

Fifth run from 10,600 to 12,658 feet
After survey : 1,002
Sixth run from 12,470 to 14,406 feet
: 1,005

These coefficients are the average values for 50 and 100 microseconds/ft interval transit time and represents the value in milliseconds read on the sonic log.

2) SONIC CALIBRATION

First and second runs

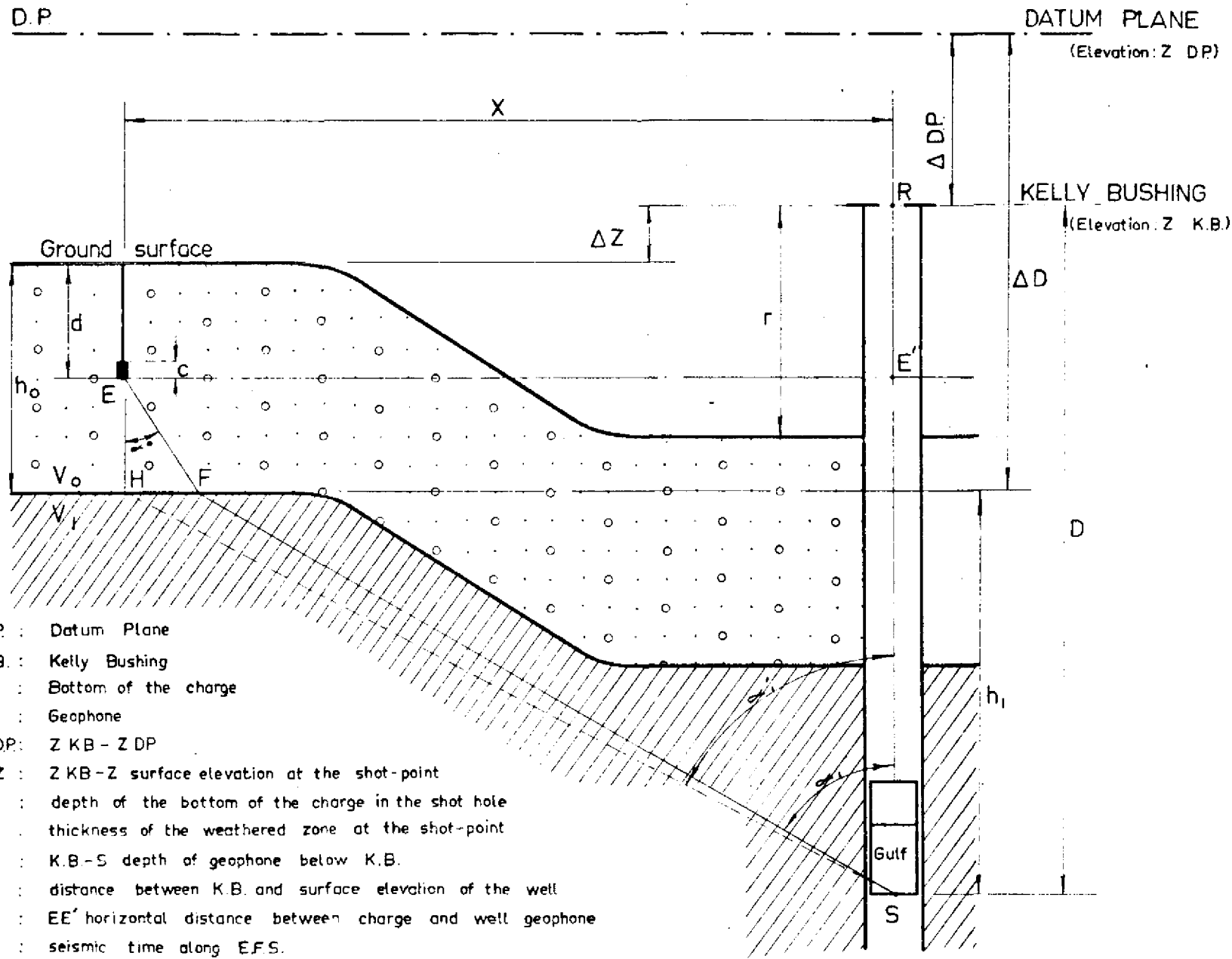
$$C = + 11$$
$$K = + 2.2 \text{ microseconds / ft}$$

Third, Fourth, Fifth and Sixth runs

$$C = + 35$$
$$K = - 2.3 \text{ microseconds / ft}$$

XXXXXXXXXXXXXXXXXXXX

INDEX OF ABBREVIATIONS



- D.P. : Datum Plane
- K.B. : Kelly Bushing
- E : Bottom of the charge
- S : Geophone
- ΔD.P. : Z KB - Z DP
- ΔZ : Z KB - Z surface elevation at the shot-point
- d : depth of the bottom of the charge in the shot hole
- h₀ : thickness of the weathered zone at the shot-point
- D : K.B.-S depth of geophone below K.B.
- r : distance between K.B. and surface elevation of the well
- X : EE' horizontal distance between charge and well geophone
- \bar{t} : seismic time along E.F.S.
- ΔT : seismic time along E.F
- T' : T - ΔT
- V₀ : vertical velocity in the weathered zone
- V₁ : vertical velocity below the weathered zone
- c : height of charge

INDEX OF CORRECTIONS

1st CASE : SHOT on the BOTTOM of the WEATHERED ZONE ($d \neq h_0$) or BELOW the WEATHERED ZONE ($d > h_0$)

T (raw time read on the record) = T' ($\Delta T = 0$)

T'' Recorded time reduced to the vertical $T' \times \frac{h_1}{L}$ where $h_1 = D - (d \pm \Delta Z)$
 $L = \sqrt{X^2 + h_1^2}$

T''' Corrected time from D.P. = $T'' + t$ where $t = \frac{\Delta D}{V_1}$ and $\Delta D = d \pm \Delta Z \pm \Delta D.P.$

2nd CASE : SHOT on the SURFACE ($d = 0$)

T' (Recorded time - time of path in the weathered zone) = $T - \Delta T$ where ΔT (seismic time in the weathered zone) = $\frac{h_0}{V_0 \cos \alpha'_0}$

T'' Time below the weathered zone reduced to the vertical = $T' \times \frac{h_1}{L}$ where $h_1 = D - (h_0 \pm \Delta Z)$
 $L = \sqrt{h_1^2 + (X - h_0 \text{tg } \alpha'_0)^2}$

T''' Corrected time from D.P. = $T'' + t$ where $t = \frac{\Delta D}{V_1}$ and $\Delta D = h_0 \pm \Delta Z \pm \Delta D.P.$

α'_0 is determined by $\sin \alpha'_0 = \sin \alpha_0 \frac{V_0}{V_1}$ and $\sin \alpha'_0 = \frac{X}{\sqrt{X^2 + h_1^2}}$

It is proved that no noticeable error is made considering:

- α'_0 maximum angle = α_0 real angle
- α'_0 approximate angle = α_0 real angle

3rd CASE : SHOT in the WEATHERED ZONE ($d \neq 0$)

Compute T', T'' and T''' as in the second case, using $\Delta T = \frac{h_0 - d}{V_0 \cos \alpha'_0}$

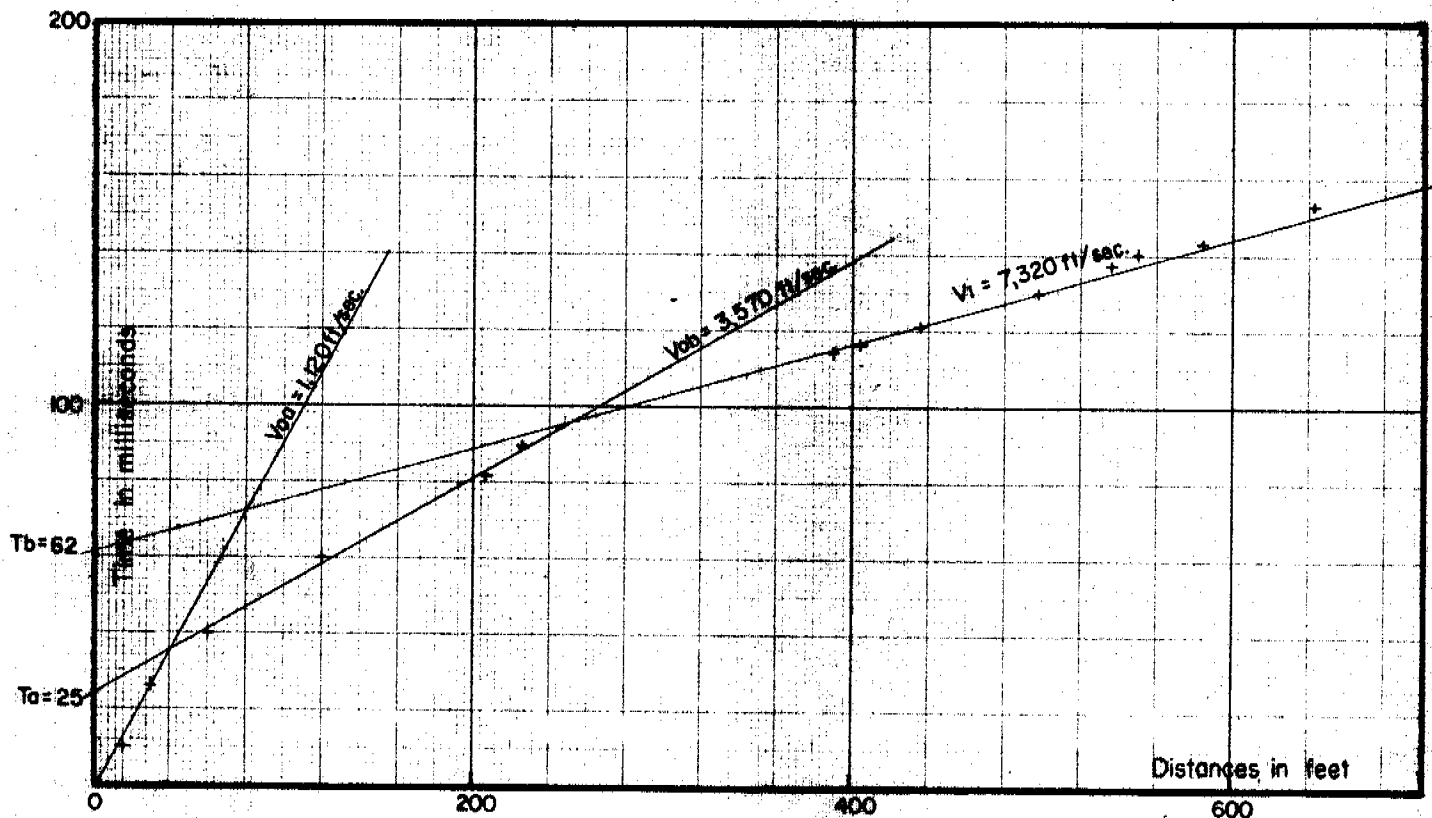
and $L = \sqrt{h_1^2 + [X - (h_0 - d) \text{tg } \alpha'_0]^2}$

NOTE : It will be admitted therefore, that in these three cases, the seismic travel F.S. is not affected by noticeable refraction effects.

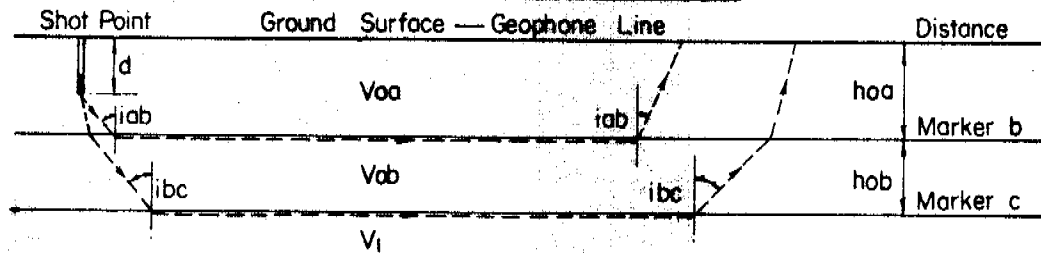
THE SECOND CASE WAS USED FOR ALL SHOTS KULSHILL No. 1.

WEATHERED ZONE

(Velocity and Depth Determination)



PRINCIPLE AND ABBREVIATIONS



COMPUTATION

$$hoa = \frac{d}{2} + \frac{Ta}{2} \times \frac{Voa}{\cos iab} \quad \text{where } \cos iab \text{ is determined by } \sin iab = \frac{Voa}{Vob}$$

$$hob = \frac{Tb}{2} \times \frac{Vob}{\cos ibc} - hoa \times \frac{Vob}{Voa} \times \frac{\cos iac}{\cos ibc} \quad \text{with } \sin ibc = \frac{Vob}{Vi} \text{ and } \sin iac = \frac{Voa}{Vi}$$

Ta = 25	Voa = 1,120 ft/sec.] on the time distance curve
Tb = 62	Vob = 3,570 ft/sec.	
Tc =	Vi = 7,320 ft/sec.	

hoa = 15	feet at 1,120	feet per second
hob = 74	feet at 3,570	feet per second

MEASUREMENT and COMPUTATION

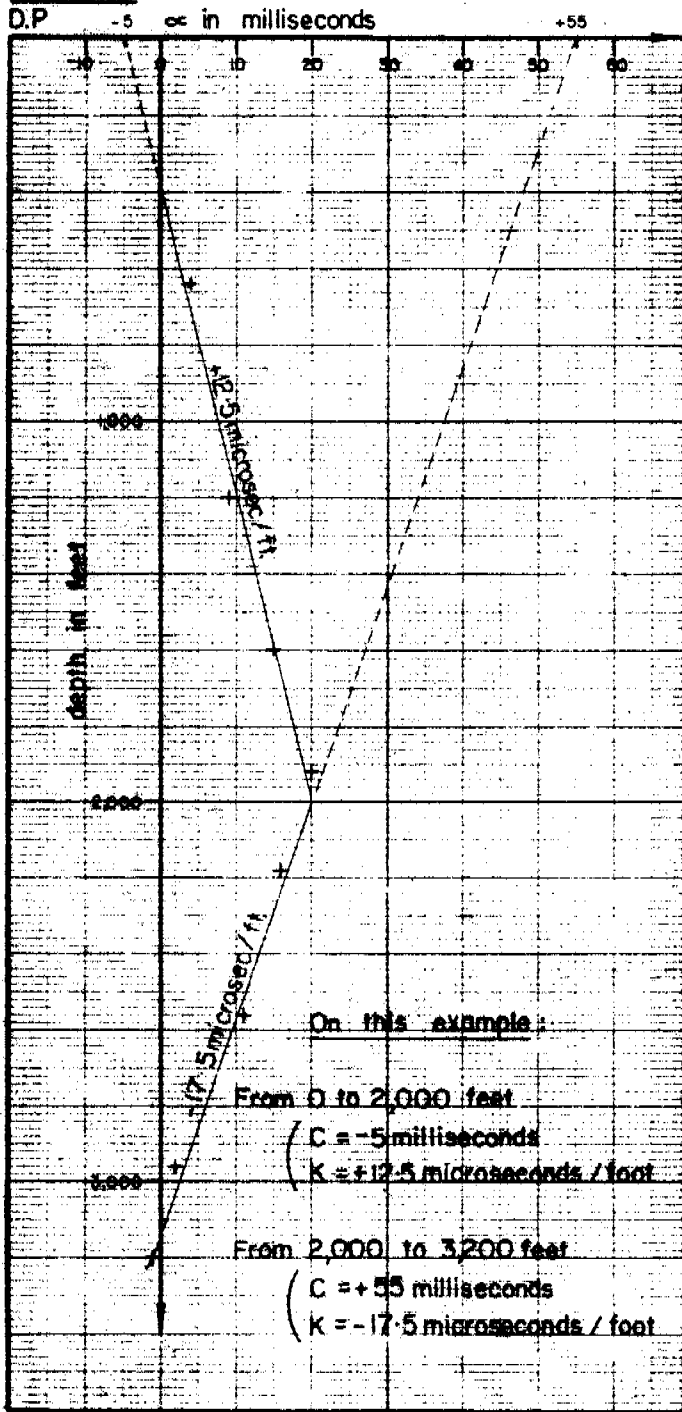
Tb. 7

SHOT POINT		No. of SHOT		D	d	ΔZ	h_i	X	$\sin \alpha'$	$\sin \alpha'o$	$\cos \alpha'o$	$Tg \alpha'o$	ΔT	L	$\frac{h_i}{L}$	t	T	Quality	T''	T'''
Row	Hole	Down	Up																	
A	1	1		300	2,5	14,4 + 1,9	283,1	205						349,5	0,810	+2,2	87	P	70,5	72,7
A	2	1 bis		300	2,5	14,4 + 1,9	283,1	205						349,5	0,810	+2,2	88	P	71,3	73,5
B	1	2		1300	0	12,7 - 2,3	1287,3	580						1411,6	0,918	-0,3	214	P	196,5	196,2
B	2	2 bis		1300	0	12,7 - 2,3	1287,3	580						1411,6	0,918	-0,3	213	P	195,5	195,2
C	1	3		3120	0	8,2 - 6,8	3111,8	726						3195,9	0,974	-0,9	390	?	379,9	379,0
C	2	4		3120	2	8,2 - 4,8	3109,8	726						3193,7	0,974	+0,9	323	nil		
D	1	4 bis		3120	4	4,7 - 7,3	3111,3	1056						3285,4	0,947	+2,1	585	nil		
C	3	5		4300	5	8,2 - 1,8	4286,8	726						4348,0	0,986	+3,6	488	F	481,2	484,8
D	2	6		5300	4	4,7 - 7,3	5291,3	1056						5395,2	0,981	+2,1	556	?	545,4	547,5
D	3	7		7300	6	4,7 - 5,3	7289,3	1056						7365,0	0,990	+3,9	707	F	699,9	703,8
D	4	8		9000	8	4,7 - 3,3	8987,3	1056						9048,9	0,993	+5,6	839	P	833,1	838,7
E	1	9		10650	0	0,6 - 14,4	10649,4	1378						10723,6	0,993	-2,0	965	P	958,2	956,2
E	2	10		13500	4	0,6 - 10,4	13495,4	1378						13565,6	0,995	+1,6	1145 ?	?	1139,3 ?	1140,9
E	3	11		14400	8	0,6 - 6,4	14391,4	1378						14456,8	0,995	+5,1	1196 ?	?	1190,0	1195,1
E	4	12		12570	13	0,6 - 1,4	12556,4	1378						12630,4	0,994	+9,6	1086	F	1079,5	1089,1
G	1	13		9950	0	30,5 + 15,5	9919,5	1280						10002,0	0,990	+2,2	915	?	905,9	908,1
D	5	14		7600	9	4,7 - 2,3	7586,3	1056						7659,1	0,990	+6,5	734	G	726,7	733,2
D	6	15		6550	10	4,7 - 1,3	6535,3	1056						6619,9	0,987	+8,9	652	G	643,5	652,4
D	7	16		5250	10	4,7 - 1,3	5235,3	1056						5340,5	0,980	+8,9	564	G	552,7	561,6
C	4	17		3120	3	8,2 - 3,8	3108,8	726						3192,6	0,974	+1,8	392	G	381,8	383,6
C	5	18		1600	3	8,2 - 3,8	1588,8	726						1746,7	0,909	+1,8	248	F	225,4	227,2
B	3	19		1300	1	12,7 - 1,3	1286,3	580						1410,9	0,912	+0,6	209	F	190,6	191,2
A	3	20		500	2,5	14,4 + 1,9	483,1	205						524,7	0,921	+2,1	107	?	98,5	100,6
F	1	21		1000	0	15 0	985	456						1085,5	0,907	0,0	161	F	146,0	146,0

SONIC CALIBRATION

Principle and Abbreviations

EXAMPLE



b: Seismic corrected times
 a: Times read on the sonic log from an arbitrary origin. This origin is chosen so that the difference $\alpha = b - a$ is small

-The value of α (positive or negative for each calibration point is plotted on a diagram, in relation to the depth D in feet .

-The points are joined with segments of a straight line the breaks of which must correspond to layer changes and / or to noticeable velocity contrasts .

- The equations of these segments determine :

1- the ordinate of the origin : Calibration constant C in msec.

2- the gradient: Calibration factor K in microsec / foot .

- Thus ,C and $K \times D$ are algebraically added to each raw sonic time (a) to obtain the corresponding sonic corrected time .

NOTE : Ideal conditions of calibration :

α = Constant for all calibration points, whence: $C = \alpha$ and $K = 0$.

SONIC CALIBRATION

Tb. 9
a

Sonic corrected time = Sonic raw time + (K × D) + calibration constant
K: calibration factor in microseconds/foot (See Tb. 10.)

ORIGIN: GROUND LEVEL

	Depth in feet from K.B.	Depth in feet from DP	Sonic raw time a	Seismic corrected time b	α (b-a)	K × D	Calibration constant c	Sonic corrected time	Average vertical velocity feet/sec	Interval velocity
	0									
	32.8	17.8	-	14.3(Seismic)				-	1,250	
	62.3	47.3	-	22.5(Seismic)				-	2,100	
	135.0	120.0	39			+0.3	+11	50.3	2,400	
	192.0	177.0	48			0.4		59.4	3,000	
	271.2	256.2	60			0.6		71.6	3,600	
A	300.0	285.0	64.1	72.7	+8.6	0.7		75.8	3,750	
A	300.2	285.0	64.1	73.5	+9.4	0.7		75.8	"	
	350.2	335.2	71.0			0.8		82.8	4,050	
	463.5	448.5	85.0			1.0		97.0	4,600	
A	500.0	485.0	89.9	100.6	+10.7	1.1		102.0	4,750	
	564.0	549.0	98.0			1.2		110.2	5,000	
	698.2	683.2	114.0			1.5		126.5	5,400	
	830.0	815.0	130.0			1.8		142.8	5,700	
F	1000.0	985.0	148.8	146.0	-2.8	2.2		162.0	6,100	
	1195.0	1180.0	170.0			2.6		183.6	6,400	
B	1300.0	1285.0	181.5	196.2	+14.7	2.9		195.4	6,550	
B	1300.0	1285.0	181.5	195.2	+13.7	"		"	"	
B	1300.0	1285.0	181.5	191.2	+9.7	"		"	"	
	1460.2	1445.2	198.0			3.2		212.2	6,800	
C	1600.0	1585.0	212	227.2	+15.2	3.5		226.5	7,000	
	1795.8	1780.8	232			4.0		247.0	7,200	
	1955.5	1940.5	248			4.3		263.3	7,350	
	2060.1	2045.1	259			4.5		274.5	7,450	
	2225.2	2210.2	276			4.9		291.9	7,550	
	2290.5	2275.5	283			5.0		299.0	7,600	
	2498.2	2483.2	304			5.5		320.5	7,750	
	2663.2	2648.2	320			5.9		336.9	7,850	
	2830.5	2815.5	336			6.2		353.2	7,950	
	2899.2	2884.2	342			6.3		359.3	8,050	
C	3120.0	3105.0	362.4	379.0	+16.6	6.9		380.3	8,150	
	3120.0	3105.0	362.4	NR		"		"	"	
	3120.0	3105.0	362.4	NR		"		"	"	
C	3120.0	3105.0	362.4	383.6	+21.2	6.9		380.3	8,150	
	3213.5	3198.5	370			7.1		388.1	8,250	
	3411.5	3396.5	386			7.5		404.5	8,400	
	3509.0	3494.0	395			7.7		413.7	8,450	
	3601.7	3586.7	403			7.9		421.9	8,500	
	3752.8	3737.8	416			8.3		435.3	8,550	
	3918.9	3903.9	432			8.6		451.6	8,650	
	3992.2	3977.2	438			8.8		457.8	8,700	
	4155.2	4140.2	452			+9.1	+11	472.1	8,750	

SONIC CALIBRATION

Tb. 9
b

Sonic corrected time = Sonic raw time + (K × D) + calibration constant
 K: calibration factor in microseconds/foot (See Tb. 10.)

ORIGIN: GROUND LEVEL

	Depth in feet from K.B.	Depth in feet from D.P.	Sonic raw time a	Seismic corrected time b	α (b-a)	K × D	Calibration constant c	Sonic corrected time	Average vertical velocity feet/sec.	Interval velocity
C	4300	4285,0	474,7	474,8	+0,6	+9,5	+11	484,7	8,850	
	4482,0	4467,0	480			9,9		500,9	8,900	
	4719,0	4704,0	500			10,4		521,4	9,050	
	4877,7	4873,7	513			10,8		534,8	9,100	
	5058,6	5043,6	526			11,1		548,1	9,200	
D	5250,0	5235,0	541,0	561,6	+20,6	+11,6	+11	563,6	9,300	
D	5300,0	5285,0	544,6	547,5	+2,9	-12,2	+35	567,4	9,300	
	5460,0	5445,0	557			-12,6		579,4	9,400	
	5520,3	5524,3	563			-12,7		585,3	9,450	
	5622,5	5607,5	569			-12,9		591,1	9,500	
	5739,3	5724,3	578			-13,2		599,8	9,550	
	5837,0	5822,0	586			-13,4		607,6	9,600	
	5919,4	5904,4	592			-13,6		613,4	9,650	
	6046,0	6031,0	602			-13,9		623,1	9,700	
	6110,7	6095,7	607			-14,1		627,9	9,700	
	6167,9	6152,9	611			-14,2		631,8	9,750	
	6221,6	6206,6	615			-14,3		635,7	9,750	
	6278,2	6263,2	619			-14,4		639,6	9,800	
	6366,3	6351,3	625			-14,6		645,4	9,850	
	6550,0	6535,0	638,2	652,4	+14,2	-15,1		658,1	9,900	
	6604,5	6589,5	642			-15,2		661,8	9,950	
	6698,0	6683,0	650			-15,4		669,6	10,000	
	6851,2	6836,2	661			-15,8		680,2	10,050	
	6930,1	6915,1	667			-15,9		686,1	10,100	
	7025,2	7010,2	674			-16,2		692,8	10,100	
	7165,5	7150,5	684			-16,5		702,5	10,150	
	7259,0	7244,0	691			-16,7		709,3	10,200	
D	7300,0	7285,0	694,3	703,8	+9,5	-16,8		712,5	10,200	
	7422,0	7407,0	704			-17,1		721,9	10,250	
	7540,8	7525,8	713			-17,3		730,7	10,300	
D	7600,0	7585,0	718	733,2	+15,2	-17,5		735,5	10,300	
	7709,2	7694,2	727			-17,7		744,3	10,350	
	7838,3	7823,5	738			-18,0		755,0	10,350	
	8015,6	8000,6	752			-18,4		768,6	10,400	
	8070,2	8055,2	757			-18,6		773,4	10,400	
	8221,6	8206,6	769			-18,9		785,1	10,450	
	8274,2	8259,2	773			-19,0		789,0	10,450	
	8315,7	8300,7	776			-19,1		791,9	10,500	
	8450,0	8435,0	787			-19,4		802,6	10,500	
	8553,9	8538,9	795			-19,7		810,3	10,550	
	8634,0	8619,0	801			-19,9		816,1	10,550	
	8695,9	8680,9	806			-20,0	+35	821,0	10,550	

SONIC CALIBRATION

Tb. 9
c

Sonic corrected time = Sonic raw time + (K × D) + calibration constant

K: calibration factor in microseconds/foot (See Tb. 10)

ORIGIN: GROUND LEVEL

	Depth in feet from K.B.	Depth in feet from D.P.	Sonic raw time a	Seismic corrected time b	α (b-a)	K × D	Calibration constant c	Sonic corrected time	Average vertical velocity feet/sec	Interval velocity
	8869.9	8854.9	817			-20.4	+35	831.6	10,650	
D	9000.0	8985.0	825.8	838.7	+12.9	-20.7		840.1	10,700	
	9123.2	9108.2	834			-21.0		848.0	10,750	
	9173.5	9158.5	837			-21.1		850.9	10,750	
	9200.4	9185.4	839			-21.2		852.8	10,750	
	9272.8	9257.8	843			-21.3		856.7	10,800	
	9377.0	9362.0	851			-21.6		864.4	10,850	
	9466.7	9451.7	857			-21.8		870.2	10,850	
	9542.0	9527.0	863			-21.9		876.1	10,900	
	9634.1	9649.1	873			-22.2		885.8	10,900	
	9827.3	9812.3	886			-22.6		898.4	10,950	
	9916.0	9901.0	893			-22.8		905.2	10,950	
G	9950.0	9935.0	895	908.1	+13.1	-22.9		907.1	10,950	
	10008.7	9993.7	899			-23.0		911.0	10,950	
	10099.9	10084.9	906			-23.2		917.8	11,000	
	10214.1	10201.1	915			-23.5		926.5	11,000	
	10305.5	10290.5	922			-23.7		933.3	11,000	
	10402.7	10387.7	931			-23.9		942.1	11,000	
	10474.2	10459.2	936			-24.1		946.9	11,050	
	10555.2	10540.2	942			-24.3		952.7	11,050	
E	10650.0	10635.0	948.3	956.2	+7.9	-24.5		958.8	11,100	
	10696.0	10681.0	951			-24.6		961.4	11,100	
	10757.3	10742.3	953			-24.7		965.3	11,150	
	10842.5	10827.5	962			-24.9		972.1	11,150	
	10917.6	10902.6	968			-25.1		977.9	11,150	
	11033.3	11018.3	975			-25.4		984.6	11,200	
	11118.5	11103.5	982			-25.6		991.4	11,200	
	11184.2	11169.2	987			-25.7		996.3	11,200	
	11235.0	11220.0	994			-26.0		1003.0	11,250	
	11348.4	11333.4	997			-26.1		1005.9	11,300	
	11459.2	11444.2	1004			-26.4		1012.6	11,300	
	11556.7	11541.7	1011			-26.6		1019.4	11,350	
	11647.0	11632.0	1016			-26.8		1024.2	11,350	
	11714.2	11699.2	1020			-26.9		1028.1	11,400	
	11790.7	11775.7	1025			-27.1		1032.9	11,400	
	11876.9	11861.9	1030			-27.3		1037.7	11,400	
	11936.6	11921.6	1034			-27.5		1041.5	11,400	
	12060.0	12045.0	1043			-27.7		1050.3	11,450	
	12138.4	12123.4	1048			-27.9		1055.1	11,500	
	12210.0	12195.0	1053			-28.0		1060.0	11,500	
	12330.3	12315.3	1061			-28.4		1067.6	11,550	
	12436.8	12421.8	1069			-28.6	+35	1075.4	11,550	

SONIC INTERVAL VELOCITIES

Tb. 10^a

Z KB: 231 ft.

ORIGIN: GROUND LEVEL

Z GL: 216 ft.

Depth in feet from K.B.	Depth in feet from D.P.	Sonic corrected time in milliseconds.	Interval depth ft.	Interval time ms.	Interval velocity in feet/second
15	0	0			
			120	50.3	2,400
135	120	50.3			
			136.2	21.3	6,400
271.2	256.2	71.6			
			79	11.2	7,050
350.2	335.2	82.8			
			113.3	14.2	8,000
463.5	448.5	97.0			
			100.5	13.2	7,650
564	549	110.2			
			134.2	16.3	8,250
698.2	683.2	126.5			
			131.8	16.3	8,100
830	815	142.8			
			170	19.2	8,850
1,000	985	162.0			
			195	21.6	9,050
1,195	1,180	183.6			
			105	11.8	8,900
1,300	1,285	195.4			
			160.2	16.8	9,550
1,460.2	1,445.2	212.2			
			139.8	14.3	9,800
1,600	1,585	226.5			
			195.8	20.5	9,550
1,795.8	1,780.8	247			
			159.7	16.3	9,800
1,955.5	1,940.5	263.3			
			104.6	11.2	9,350
2,060.1	2,045.1	274.5			
			165.1	17.4	9,500
2,225.2	2,210.2	291.9			
			65.3	7.1	9,300
2,290.5	2,275.5	299			
			207.7	21.5	9,650
2,498.2	2,483.2	320.5			
			165	16.4	10,050
2,663.2	2,648.2	336.9			
			167.3	16.3	10,250
2,830.5	2,815.5	353.2			
			68.7	6.1	11,250
2,899.2	2,884.2	359.3			
			220.8	21	10,500
3,120	3,105	380.3			
			83.5	7.8	12,000
3,213.5	3,198.5	388.1			

SONIC INTERVAL VELOCITIES

Tb. 10^b

Z KB: 231 ft.

ORIGIN: GROUND LEVEL

Z GL: 216 ft.

Depth in feet from K.B.	Depth in feet from D.P.	Sonic corrected time in milliseconds.	Interval depth	Interval time	Interval velocity in feet/second
3,213.5	3,198.5	388.1			
			198	16.4	12,100
3,411.5	3,396.5	404.5			
			97.5	9.2	10,600
3,509.	3,494	413.7			
			92.7	8.2	11,300
3,601.7	3,586.7	421.9			
			151.1	13.4	11,300
3,752.8	3,737.8	435.3			
			166.1	16.3	10,200
3,918.9	3,903.9	451.6			
			73.3	6.2	11,800
3,992.2	3,977.2	457.8			
			163	14.3	11,400
4,155.2	4,140.2	472.1			
			144.8	12.6	11,500
4,300	4,285	484.7			
			182	16.2	11,250
4,482	4,467	500.9			
			237	20.5	11,550
4,719	4,704	521.4			
			169.7	13.4	12,700
4,888.7	4,873.7	534.8			
			169.9	13.3	12,800
5,058.6	5,043.6	548.1			
			191.4	15.5	12,350
5,250	5,235	563.6			
			210	15.8	13,300
5,460	5,445	579.4			
			79.3	5.9	13,400
5,539.3	5,524.3	585.3			
			83.2	5.8	14,300
5,622.5	5,607.5	591.1			
			116.8	8.7	13,400
5,739.3	5,724.3	599.8			
			97.7	7.8	12,500
5,837	5,822	607.6			
			82.4	5.8	14,200
5,919.4	5,904.4	613.4			
			126.6	9.7	13,050
6,046	6,031	623.1			
			64.7	4.8	13,500
6,110.7	6,095.7	627.9			
			57.2	3.9	14,650
6,167.9	6,152.9	631.8			
			110.3	7.8	14,100
6,278.2	6,263.2	639.6			

SONIC INTERVAL VELOCITIES

Tb. 10

Z KB: 231 ft

ORIGIN: GROUND LEVEL

Z GL: 216 ft

Depth in feet from K.B.	Depth in feet from D.P.	Sonic corrected time in milliseconds.	Interval depth	Interval time	Interval velocity in feet/second
6,278.2	6,263.2	639.6			
			88.1	5.8	15,200
6,366.3	6,351.3	645.4			
			238.2	16.4	14,500
6,604.5	6,589.5	661.8			
			93.8	7.8	12,000
6,698	6,683	669.6			
			153.2	10.6	14,400
6,851.2	6,836.2	680.2			
			78.9	5.9	13,400
6,930.1	6,915.1	686.1			
			95.1	6.7	14,200
7,025.2	7,010.2	692.8			
			140.3	9.7	14,500
7,165.5	7,150.5	702.5			
			93.5	6.8	13,750
7,259	7,244	709.3			
			163	12.6	12,950
7,422	7,407	721.9			
			118.8	8.8	13,500
7,540.8	7,525.8	730.7			
			168.4	13.6	12,400
7,709.2	7,694.2	744.3			
			129.1	10.7	12,100
7,838.3	7,823.3	755.0			
			177.3	13.6	13,050
8,015.6	8,000.6	768.6			
			54.6	4.8	11,400
8,070.2	8,055.2	773.4			
			151.4	11.7	12,950
8,221.6	8,206.6	785.1			
			52.6	3.9	13,500
8,274.2	8,259.2	789			
			41.5	2.9	14,300
8,315.7	8,300.7	791.9			
			134.3	10.7	12,550
8,450	8,435	802.6			
			103.9	7.7	13,500
8,553.9	8,538.9	810.3			
			80.1	5.8	13,800
8,634	8,619	816.1			
			61.9	4.9	12,600
8,695.9	8,680.9	821			
			174	10.6	16,400
8,869.9	8,854.9	831.6			
			253.3	16.4	15,400
9,123.2	9,108.2	848			

SONIC INTERVAL VELOCITIES

Tb. 10

Z KB. 231 ft.

ORIGIN: GROUND LEVEL

Z GL. 216 ft.

Depth in feet from K.B.	Depth in feet from D.P.	Sonic corrected time in milliseconds.	Interval depth	Interval time	Interval velocity in feet/second
9,123.2	9,108.2	848			
			77.2	4.8	16,100 ?
9,200.4	9,185.4	852.8			
			72.4	3.9	18,550
9,272.8	9,257.8	856.7			
			104.2	7.7	13,500
9,377	9,362	864.4			
			89.7	5.8	15,500
9,466.7	9,451.7	870.2			
			75.3	5.9	12,800
9,542	9,527	876.1			
			122.1	9.7	13,250
9,664.1	9,649.1	885.8			
			163.2	12.6	12,850
9,827.3	9,812.3	898.4			
			88.7	6.8	13,050
9,916	9,901	905.2			
			34	1.9	17,900
9,950	9,935	907.1			
			58.7	3.9	15,050
10,008.7	9,993.7	911.0			
			205.4	15.5	13,200
10,214.1	10,199.1	926.5			
			91.4	6.8	13,450
10,305.5	10,290.5	933.3			
			97.2	8.8	11,050
10,402.7	10,387.7	942.1			
			71.5	4.8	14,900
10,474.2	10,459.2	946.9			
			81	5.8	13,950
10,555.2	10,540.2	952.7			
			94.8	6.1	15,550
10,650	10,635	958.8			
			46	3.6	12,800
10,696	10,681	961.4			
			61.3	3.9	15,700
10,757.3	10,742.3	965.3			
			160.3	12.6	12,700
10,917.6	10,902.6	977.9			
			115.7	6.7	17,150
11,033.3	11,018.3	984.6			
			150.9	11.7	12,900
11,184.2	11,169.2	996.3			
			164.2	9.6	17,100
11,348.4	11,333.4	1005.9			
			110.8	6.7	16,550
11,459.2	11,444.2	1012.6			

SONIC INTERVAL VELOCITIES

Tb. 10

Z KB. 231 #

ORIGIN: GROUND LEVEL

Z GL 216 ft

Depth in feet from K.B.	Depth in feet from D.P.	Sonic corrected time in milliseconds.	Interval depth	Interval time	Interval velocity in feet/second
11,459.2	11,444.2	1,012.6			
			97.5	6.8	14,300
11,556.7	11,541.7	1,012.4			
			157.5	8.7	18,100
11,714.2	11,699.2	1,028.1			
			76.5	4.8	15,900
11,790.7	11,775.7	1,032.9			
			86.2	4.8	17,950
11,876.9	11,861.9	1,037.7			
			59.7	3.8	15,700
11,936.6	11,921.6	1,041.5			
			123.4	8.8	14,000
12,060	12,045	1,050.3			
			78.4	4.8	16,350
12,138.4	12,123.4	1,055.1			
			71.6	4.9	14,600
12,210	12,195	1,060			
			120.3	7.6	15,800
12,330.3	12,315.3	1,067.6			
			202.4	14.6	13,850
12,532.7	12,517.7	1,082.2			
			246.3	15.4	16,000
12,779	12,764	1,097.6			
			286.	18.4	15,550
13,065	13,050	1,116.			
			123	7.7	15,950
13,188	13,173	1,123.7			
			156	9.6	16,250
13,344	13,329	1,133.3			
			156	9.6	16,250
13,500	13,485	1,142.9			
			134	7.7	17,400
13,634	13,619	1,150.6			
			164	9.7	16,900
13,798	13,783	1,160.3			
			128	7.7	16,650
13,926	13,911	1,168			
			134	7.7	17,400
14,060	14,045	1,175.7			
			118	6.7	17,600
14,178	14,163	1,182.4			
			120	6.7	17,900
14,298	14,283	1,189.1			
			102	6.	17,000
14,400	14,385	1,195.1			