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A VELOCITY DISTRIBUTION FROM SURFACE TO THE BLYTHESDALE GROUP

IN THE WESTERN PORTION OF THE GREAT ARTESIAN BASIN

CALCULATED FROM T DELTA T ANALYSIS OF REFLECTION PROFILES

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During the period August 1958 to November 1961, a S.A. Department of Mines Seismic Party spent 27 crew months shooting reconnaissance reflection profiles (mainly character and interval correlation at 2 mile station spacing) over the traverses shown on Location Plan 62-361. Time cross sections have been prepared for these lines with contour plans of some horizons using (a) the velocity distribution obtained from a well velocity survey of Delhi-Frome-Santos Innamincka No. 1 Well[I] and (b) time-depth curves computed from a TdeltaT analysis of reflections[2]. The velocity distribution obtained from the well shoot at Innamincka N_0. 1 is the only one established in this manner in the South Australian portion of the Great Artesian Basin at the time of writing.

Over most of the lines shot it is possible to correlate reflections assumed to originate near the top of the Blythesdale Group. These reflections which have been labelled "C", are frequently of fair to good quality, and an average velocity to the reflector can be calculated with a fair degree of reliabilit; using TdeltaT analysis[3]. The two-way reflection time from the surface at the shot point and the normal move-out (deltaT) obtained by averaging the difference in time from the shot point to the outside traces of split spreads (the latter corrected for elevation and weathering differences) were recorded for correlated reflections from more than 400 shot points. These were averaged in groups of .050 second from .300 to 1.400 second, the range over which the "C" reflection extends (see Table 1). Average velocities were calculated from the average

values of T and deltaT using the formula:

$$\bar{V} = 1200/(2T\text{deltaT})^{\frac{1}{2}} \text{ feet/second,}$$

the distance from shot point to the outside trace being 1200 ft.

On plotting the values of $\bar{V}$ against T, it appears that the relationship $\bar{V} = f(T)$ is not linear. A regression curve of the form:

$$y = a_1 + a_2 x + a_3 x^2 \text{ was fitted to the data}[4] \text{ and the}$$

following equation derived:

$$\bar{V} = 4730 + 3400T - 860T^2 \text{ (see drawing L62-19),}$$

where T is the two-way time from the surface at the shot point.

Assuming straight line travel paths, i.e.

$$Z = \tfrac{1}{2}VT,$$

a function relating depth to time was calculated, viz.,

$$Z = 2365T + 1700T^2 - 430T^3 \text{ (see drawing L62-20).}$$

From a graph of this function, depths to the "C" reflector have been found at shot points contiguous to a number of water and oil exploration bores.

Table II shows reflection depths compared with well intersections.. In a number of cases, as indicated in the table, the depth of the "C" reflector at the bore has been estimated by extrapolating the reflection data; in some other cases it has not been possible to do this as the nearest shot point is some distance from the bore (the mileage is shown in the second column of the table against the shot point number) and to enable a more valid comparison to be made of the relative depths, notes on trends between shot points and bore for several individual cases have been appended to the table.

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South Australia and Queensland - S.A. Department of Mines -
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(3)   Seismic Prospecting for Oil - Dix (Harper) - Sec. 7.3

(4)   Statistical Methods for Research Workers - R.A. Fisher

      (Oliver & Boyd)

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TABLE I

Average values of T and delta T in groups of .050 second

From	To	No.of Observations	Total T	Total deltaT	Average T	Average delta T	Velocity ft./sec.	Depth Ft.
1.400	1.351	17	23.459	.1456	1.380	.0086	7780	5370
1.350	1.301	88	116.492	.8145	1.324	.0093	7670	5070
1.300	1.251	97	123.916	.9045	1.278	.0093	7770	4970
1.250	1.201	44	54.070	.4525	1.229	.0103	7540	4630
1.200	1.151	45	52.834	.4970	1.174	.0110	7450	4380
1.150	1.101	50	56.002	.5820	1.120	.0116	7430	4160
1.100	1.051	105	112.671	1.2850	1.073	.0122	7400	3970
1.050	1.001	81	83.106	1.0545	1.026	.0130	7340	3770
1.000	.951	124	120.072	1.7365	.968	.0140	7290	3530
.950	.901	59	54.816	.8695	.929	.0147	7250	3370
.900	.851	23	20.099	.3665	.874	.0159	7190	3140
.850	.801	58	47.706	1.0485	.823	.0181	6960	2860
.800	.751	102	78.978	2.0235	.774	.0198	6850	2650
.750	.701	48	35.085	1.0755	.731	.0224	6630	2420
✱ .700	.601	12	7.832	.3275	.653	.0273	6360	2080
✱ .600	.501	9	4.898	.2935	.544	.0326	6370	1730
✱ .500	.401	7	3.147	.3150	.450	.0450	5970	1340
.400	.351	8	2.964	.4280	.371	.0535	6030	1120

✱ Observations in groups of .100 second

TABLE II

Relative Depths of "C" Reflection from TdeltaT Analysis and Well Intersections

Bores	Contiguous Shot Points		Shot Point Elevation (above M.S.L.)	"C" Reflection			Well Intersection	
				Time from Surface	Depth below surface	Depth below M.S.L.	Depth below M.S.L.	
Dulkaninna	BM126/S2	3½m	107	.730?	2458	2360	1979	Artesian aquifer
Cannuwauka-ninna	BM119	⅜m	54	.817	2825	2740 ✱	2695	" "
	BM120	1⅝m	60	.779	2663			
Kopper-manna	BM112/N2	⅛m	44	.857	3000	2960	2859	" "
Mulka	BM101	1¼m	180	.935	3345			
	BM101½	3¼m	175	.872	3065	3310	3218	" "
	BM102	1⅝m	162	.915	3255			
Munger-annie	BM88½	⅜m	185	.928	3315	3170	3076	" "
	BM89	⅝m	175	.948	3400			
Mirra Mitta	BM77/81	¼m	106	.957	3443	3340	3211	" "
Kaladeina	MMK13	2 7/16m	273	1.083	4005	3730	3707	" "
Mount Gason	BM61½	11/16m	103	1.151	4315	4090	4054	" "
	BM62	13/32m	113	1.108	4123			
Goyders Lagoon	BM47	2, 3/16m	78	1.292	4965	4390	4555	" "
	BM48	2¼m	78	1.257	4705	4630		
Birdsville	BM1	¾m	139	1.064	3920	3760	3530	Transition
	BB1	⅞m	148	1.055	3880		3696	Mooga beds
Cacoory	RC16	½m	242	.807	2785	2540	2556	Artesian aquifer (surface)
Cluny No.4	RC35	1¾m	265	.717	2400	2140	1975	" "
Bedourie No.2	CB28	½m	291	.412	1230	940	1189	" " (surface)
D.F.S. Beetoota No. 1	117/S1	¼m	344	.941	3373	3030	2885 / 3095	Trans. beds / Mooga
D.F.S. Innamincka No.1	230/4	¼m	399	1.077	3980	3580	3514 / 3975	Trans. beds / Mooga

✱ Depths extrapolated from relative positions of shot points to bore site

Dulkaninna: Shot point BM126/S2 3½ miles north of bore. The general tren of the basin in this area is a gentle dip to the north.

Goyders Lagoon: Extrapolation is most uncertain due to lack of data.

Cluny No. 4: From data available, horizon appears nearly flat between that point and bore.

The intersections listed for the water bores are from drillers' logs. They probably represent the top of the Mooga Sandstone, but could be thinner sandstone aquifers within the transition beds above the Mooga.

Dullingari					4920	4615	4172 / 4435	Bly / Mooga
Orientos					4790	4030	3899	Mooga
Pandieburra				116?	4390	4250	4057 / 4253	Trans / Mooga