II. MEASUREMENT OF CHEMICAL/PHYSICAL PROPERTIES

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INTRODUCTION

At all DSDP Leg 36 sites, direct and indirect measurements of the following physical parameters were made: water content, wet bulk density, porosity, sonic velocity, and acoustic impedance. These determinations were made at closely spaced intervals along the sedimentary column recovered near the top of the elevated unit of the Malvinas Plateau.[1]

This submarine province has been intensively studied during the past few years in its geological and geophysical aspects, mainly by Lamont-Doherty Geological Observatory expeditions in the South Atlantic, in an effort to better understand its relationship with the history and evolution of the Argentine Basin and, in a more general way, to study the opening of the South Atlantic Ocean. The density of data now available, including seismic reflection profiles and compressional velocities determined with the use of sonobuoys while reflection profiling, helped to select drilling sites which could render the highest scientific profile. As a byproduct of this effort, the direct measurement of physical properties of deep-seated sediments was intended to obtain models of the structure of the oceanic crust down to the maximum possible depth below the sea floor, which at present is about 1000 meters for present-day drilling capabilities, and to compare these determinations with those obtained in a very general way by theoretical estimates or by geophysical indirect methods.

WATER CONTENT, POROSITY, AND WET BULK DENSITY (TABLE 1)

Water content, porosity, and wet bulk density are determined onboard *Glomar Challenger* utilizing two different techniques, namely (1) gravimetric and volume techniques, and (2) gamma ray attenuation techniques. Although both methods are proven to be reasonably accurate and hence correlatable to each other when utilized in shore laboratories under no limitations of time of sampling procedures, experience gained in this and other cruises suggests that the sampling and measurement techniques used onboard can show relative discrepancies in excess of 15% if great care is not observed in every step taken during the sampling of the cores and in the measurements performed. In general, restrictions imposed on time by the drilling schedule and by the considerable number of samples to be processed by the available personnel imply that the resulting data will be relatively questionable. On the other hand, if the nature and expected accuracy of each single measurement have been properly registered and evaluated, this can result in a set of data very useful for general purposes and compatible for comparison with other physical properties in terms of trends and relative variability of the physical parameters involved.

An effort was made to obtain the maximum information possible on the in situ conditions of the unconsolidated and consolidated sediments and basement rocks recovered by drilling, but these conditions were in many cases impossible to attain, partly because drilling techniques currently utilized substantially modify many of the in situ physical properties. Some of those "disturbances" can be readily detected by visual observation, but others (for example, the effect of drilling in the modification of porosity of clays of low in situ water content) are more difficult to evaluate.

The centers of the cores are hopefully the areas of minimum disturbance and are, consequently, those from which the individual samples to be processed by the gravimetric methods were taken, except when additional samples were required, undisturbed or not, in order to support complementary data used for correction of the gamma ray attenuation technique. The relative induration of the sediments recovered determined the use of two different methods for gravimetric determinations, namely: the Syringe Technique, and the Rock "Chunk" Technique. The gravimetric techniques and salt corrections (Hamilton, 1959) are discussed in Boyce, 1973. The data processed during Leg 36 is presented here without salt corrections.

Syringe Technique

The Syringe Technique can only be used with soft sediments, normally those found in the upper section of the recovered sedimentary column. This simple technique allows determination of porosity, wet bulk density, and water content, and was normally performed immediately after the cores were split in halves for laboratory description and analysis. A calibrated 1-cc syringe with the leading edge cut off and squared was inserted at selected points along the center of the split core sections. Samples were thus taken in a similar manner as piston cores in order to prevent disturbance of the sediments by laboratory sampling. By extruding the syringe and measuring the volumes of the wet samples and their wet and dry weights, water content

[1]Followed here is the use common in Argentine scientific literature of Malvinas Plateau. In English scientific literature, the name Falkland Plateau is used.

TABLE 1
Gravimetric Measurements

Core-Section	Sample Depth (m)	Water Content	Porosity	Wet Bulk Density	Sampling Technique
Hole 327A					
1-3	7.27	45.01	68.37	1.519	S
2-3	17.49	49.20	72.80	1.480	S
2-4	18.00	51.98	74.10	1.426	S
3-2	25.60	64.97	80.93	1.246	S
5-5	49.50	68.47	85.50	1.249	S
5-5	49.91	71.11	86.80	1.221	S
6-4	57.10	72.96	86.07	1.180	S
7-1	62.10	72.53	91.43	1.261	S
8-3	74.50	53.43	71.70	1.342	S
8-5	77.50	49.37	70.10	1.420	S
9-5	87.50	52.88	75.67	1.431	S
9-6	88.00	50.32	72.27	1.436	S
9-6	88.35	48.24	70.63	1.464	S
9-6	88.63	50.01	74.67	1.493	S
10-2	92.42	48.57	72.00	1.482	S
10-3	93.50	48.87	73.20	1.498	S
11-1	99.00	48.19	69.20	1.436	S
11-1	99.30	52.48	73.94	1.409	S
12-4	114.00	40.75	60.27	1.479	S
13-2	139.50	31.88	50.10	1.572	S
13-2	139.92	41.04	63.30	1.542	S
14-3	150.50	39.64	54.83	1.383	S
14-6	154.67	23.07	40.87	1.771	S
14-6	154.97	49.36	72.33	1.465	S
14-6	155.42	35.27	57.80	1.639	S
15-2	177.60	30.53	51.07	1.673	S
16-4	189.45	31.39	–	–	S
16-4	190.40	29.63	53.23	1.796	S
16-5	191.55	33.82	55.27	1.634	S
16-5	191.60	33.83	55.07	1.628	S
16-6	192.77	32.07	57.45	1.791	S
17-2	215.78	29.38	–	–	S
18-1	223.58	25.48	47.16	1.851	S
18-2	225.71	29.97	53.45	1.784	R
18-4	228.66	29.77	53.27	1.789	R
18-5	230.41	33.26	58.44	1.757	S
19-2	253.12	26.74	48.48	1.813	R
20-1	280.67	26.84	49.73	1.853	R
20-2	281.82	28.27	51.12	1.809	R
21-3	312.07	22.45	44.20	1.969	R
21-3	312.35	24.59	46.77	1.902	R
21-4	313.51	43.18	79.01	1.830	R
22-1	337.52	20.54	39.12	1.905	R
22-1	337.75	27.60	47.72	1.729	R
22-2	338.50	19.63	38.38	1.955	R
22-2	338.93	17.54	31.45	1.793	R
22-3	339.85	24.76	52.18	2.107	R
22-3	340.89	34.25	56.37	1.646	R
23-1	366.00	23.09	43.82	1.898	R
23-2	367.81	7.61	18.06	2.373	R
24-1	393.84	4.98	12.41	2.492	R
24-1	394.28	13.10	27.99	2.137	R
24-2	396.41	9.41	19.81	2.106	R
25-1	422.81	11.53	25.49	2.210	R
25-2	424.99	19.61	38.56	1.966	R
25-3	426.49	21.44	40.91	1.908	R
26-1	451.64	20.84	40.73	1.954	R
27-1	460.65	23.06	42.79	1.856	R
27-1	460.79	8.69	20.27	2.333	R
Hole 328					
1-1	1.11	50.26	73.90	1.470	S
1-2	2.00	56.27	78.57	1.396	S
1-2	2.94	53.58	74.63	1.393	S
1-3	4.10	57.93	78.43	1.354	S
1-4	5.25	56.05	77.03	1.374	S

TABLE 1 – *Continued*

Core-Section	Sample Depth (m)	Water Content	Porosity	Wet Bulk Density	Sampling Technique
Hole 328 *Continued*					
1-5	7.20	58.20	77.63	1.334	S
2-4	13.24	53.66	75.23	1.402	S
3-1	17.50	51.70	62.49	1.209	S
3-1	18.07	54.29	74.50	1.372	S
3-2	19.76	58.17	85.28	1.466	S
3-3	20.33	55.93	77.52	1.386	S
3-3	20.95	54.19	77.23	1.425	S
3-4	21.77	53.47	74.67	1.396	S
3-4	22.25	56.35	78.64	1.396	S
3-5	23.27	53.77	72.24	1.344	S
3-5	23.75	53.26	–	–	S
3-5	23.80	53.62	–	–	S
3-5	24.42	49.91	88.07	1.765	S
3-6	24.50	51.72	71.60	1.384	S
3-6	24.93	54.19	71.40	1.318	S
3-6	25.66	60.40	74.93	1.241	S
4-2	47.78	56.13	78.62	1.401	S
4-2	48.26	55.34	77.33	1.397	S
4-3	49.30	53.60	75.37	1.406	S
4-4	50.18	56.96	78.20	1.373	S
5-2	94.77	57.30	79.48	1.387	S
5-3	96.37	54.46	77.80	1.429	S
6-1	141.32	48.25	72.16	1.496	S
6-2	142.41	48.46	72.73	1.501	S
6-2	142.80	48.47	77.05	1.590	S
6-2	143.01	49.01	73.33	1.496	S
6-3	144.00	47.55	72.92	1.533	S
7-4	193.85	41.93	68.45	1.632	S
7-4	193.88	43.89	70.28	1.601	S
8-3	239.65	41.99	64.45	1.535	S
10-1	330.81	38.78	64.05	1.652	R
10-1	330.90	33.79	58.93	1.744	R
11-1	359.59	30.71	54.64	1.779	R
11-1	359.75	29.38	53.25	1.813	R
11-1	360.15	28.43	52.92	1.862	R
11-3	362.69	30.70	55.21	1.798	R
11-3	362.97	29.27	52.24	1.785	R
11-3	363.25	29.16	53.55	1.837	R
11-4	364.38	28.75	52.83	1.837	R
11-4	364.58	29.43	53.75	1.826	R
11-4	364.68	26.80	63.21	2.358	R
11-5	365.59	30.77	55.26	1.796	R
11-6	366.72	30.79	55.02	1.787	R
11-6	367.35	31.97	56.93	1.781	R
11-6	367.89	32.60	57.53	1.765	R
12-1	387.67	25.79	49.19	1.908	R
12-1	388.06	30.51	54.73	1.794	R
12-1	388.45	21.31	41.96	1.969	R
12-1	388.76	24.65	46.77	1.897	R
12-2	389.17	26.83	50.54	1.884	R
12-6	396.00	27.97	52.45	1.876	R
12-6	396.20	26.45	50.29	1.901	R
Hole 328B					
1-2	9.68	55.51	74.70	1.346	S
1-3	11.79	53.63	75.53	1.408	S
1-4	12.94	55.22	75.50	1.367	S
1-5	14.22	53.88	75.87	1.408	S
1-6	15.60	54.05	76.53	1.416	S
1-6	15.66	53.06	75.53	1.424	S
2-1	17.68	55.93	77.50	1.386	S
2-2	19.52	55.78	78.63	1.410	S
2-3	21.43	52.62	75.03	1.426	S
2-4	22.67	57.66	80.30	1.393	S
2-5	24.18	53.53	72.37	1.352	S
2-6	25.26	52.31	71.38	1.364	S
2-6	25.95	54.46	76.37	1.402	S

TABLE 1 – *Continued*

Core-Section	Sample Depth (m)	Water Content	Porosity	Wet Bulk Density	Sampling Technique
Hole 328B *Continued*					
3-1	27.65	54.06	–	–	S
3-1	28.13	64.48	80.17	1.243	S
3-2	29.18	63.04	80.80	1.282	S
3-3	30.75	63.62	76.23	1.198	S
3-4	32.16	60.25	78.83	1.308	S
3-5	33.40	61.77	81.16	1.314	S
3-6	35.20	51.43	74.83	1.455	S
3-6	35.36	51.56	73.56	1.427	S
4-1	36.76	51.88	74.23	1.431	S
4-1	36.80	52.23	74.13	1.419	S
4-1	37.10	53.02	74.80	1.411	S
4-2	38.83	56.33	76.53	1.359	S
4-4	41.18	53.47	76.23	1.426	S
4-5	42.98	57.24	76.53	1.337	S
5-1	46.40	60.17	80.87	1.344	S
5-1	46.80	55.74	76.67	1.375	S
5-1	46.96	58.50	79.00	1.350	S
5-1	47.21	53.66	74.80	1.394	S
5-2	48.16	54.84	77.73	1.417	S
5-3	49.30	62.39	82.77	1.327	S
5-3	50.07	60.76	79.80	1.313	S
5-4	50.75	58.92	80.68	1.369	S
5-5	52.27	57.40	78.43	1.366	S
5-5	53.07	57.62	79.13	1.373	S
5-6	53.84	58.88	79.27	1.346	S
6-1	55.81	53.80	75.27	1.399	S
6-2	57.28	47.76	63.13	1.322	S
6-3	58.68	57.40	75.47	1.315	S
6-4	60.28	56.07	78.57	1.401	S
6-5	61.75	59.21	79.72	1.346	S
6-6	63.21	49.35	66.67	1.351	S
7-1	435.68	26.67	50.61	1.897	R
7-2	437.58	27.67	52.06	1.881	R
7-3	439.67	29.16	53.40	1.831	R
7-4	441.36	31.07	56.21	1.809	R
7-5	441.57	26.13	50.59	1.936	R
7-6	443.17	28.98	53.37	1.841	R
7-6	444.00	26.32	50.62	1.923	R
Hole 329					
1-2	2.38	36.11	60.03	1.662	S
1-3	3.59	54.46	75.23	1.381	S
1-4	5.32	59.40	78.90	1.328	S
1-5	7.17	64.82	–	–	S
1-6	7.88	60.56	79.13	1.307	S
2-1	9.82	48.82	70.88	1.452	S
2-3	12.60	43.95	67.84	1.544	S
2-4	13.35	45.94	69.24	1.507	S
2-4	14.39	43.89	67.36	1.535	S
2-5	15.26	50.22	–	–	S
2-5	15.30	43.05	66.83	1.552	S
2-6	16.33	43.07	66.95	1.555	S
2-6	16.89	49.18	75.36	1.532	S
3-1	18.60	49.60	71.20	1.436	S
3-2	20.62	49.69	71.10	1.431	S
3-3	21.50	53.13	73.87	1.390	S
3-3	22.13	56.55	75.93	1.343	S
4-4	32.80	56.84	65.93	1.160	S
5-6	44.83	56.60	–	–	S
7-4	61.61	55.87	75.93	1.359	S
8-5	72.12	48.20	71.50	1.484	S
8-5	72.63	51.70	–	–	S
8-6	74.32	58.05	–	–	S
9-4	80.77	59.14	77.20	1.305	S
10-1	85.21	54.19	73.93	1.364	S
10-4	89.94	56.29	75.41	1.340	S
10-5	91.26	49.16	72.60	1.477	S
10-5	91.78	55.49	–	–	S
10-6	93.01	48.11	71.10	1.478	S

TABLE 1 – *Continued*

Core-Section	Sample Depth (m)	Water Content	Porosity	Wet Bulk Density	Sampling Technique
Hole 329 *Continued*					
10-6	93.28	49.08	71.07	1.448	S
11-1	95.35	59.41	–	–	S
11-2	96.40	62.82	–	–	S
11-3	97.81	51.09	–	–	S
11-4	99.16	50.99	–	–	S
11-6	102.10	58.99	78.10	1.324	S
12-1	104.79	44.70	67.73	1.515	S
12-2	105.74	55.38	75.37	1.361	S
12-3	107.64	41.39	62.90	1.520	S
12-4	109.33	42.21	65.73	1.557	S
12-5	110.89	45.66	–	–	S
12-6	112.88	49.85	70.53	1.415	S
13-1	114.28	51.74	72.97	1.410	S
13-2	115.79	51.85	70.97	1.369	S
13-3	116.88	54.26	–	–	S
13-4	118.76	45.63	68.64	1.504	S
13-5	120.07	53.75	75.20	1.399	S
13-6	121.78	41.31	64.13	1.552	S
14-1	123.94	52.06	85.85	1.649	S
14-2	125.58	50.20	71.03	1.415	S
14-3	126.50	49.19	–	–	S
14-4	128.33	49.58	70.36	1.419	S
14-5	129.27	41.77	65.50	1.568	S
14-6	131.76	47.70	69.93	1.466	S
15-1	133.44	39.15	62.33	1.592	S
15-3	136.65	45.02	67.47	1.499	S
15-4	137.94	44.03	66.74	1.516	S
16-5	148.82	39.93	64.47	1.614	S
17-2	153.57	41.26	61.05	1.480	S
17-5	158.70	42.33	65.10	1.538	S
18-2	163.03	45.28	65.77	1.452	S
18-4	166.50	43.02	63.20	1.469	S
18-5	167.34	40.01	61.83	1.545	S
19-1	171.07	46.89	67.80	1.446	S
19-2	171.92	50.37	71.93	1.428	S
19-3	173.52	46.89	66.77	1.424	S
19-3	173.64	49.49	69.80	1.411	S
19-4	174.81	50.96	70.00	1.374	S
20-1	190.17	57.35	73.83	1.287	S
20-2	191.32	57.02	75.50	1.324	S
20-3	193.82	48.42	69.43	1.434	S
20-4	194.40	47.30	66.50	1.406	S
20-4	194.49	51.76	72.53	1.401	S
20-5	196.42	45.23	66.70	1.475	S
20-6	197.32	49.86	70.67	1.417	S
20, CC	198.60	47.40	68.42	1.443	R
21-3	211.67	53.07	70.69	1.332	S
21-3	211.71	51.55	71.87	1.394	S
21-3	212.20	53.03	72.97	1.376	S
21-4	212.69	42.27	65.17	1.542	S
21-4	213.23	43.49	65.93	1.516	S
21-4	213.26	45.81	66.63	1.455	S
21-4	213.35	45.81	66.03	1.441	S
22-2	238.22	55.88	74.13	1.327	R
22-2	238.24	57.10	75.82	1.328	R
22-2	239.47	51.20	71.28	1.392	R
22-3	240.46	54.80	74.11	1.352	R
22-3	240.48	51.92	71.37	1.374	R
22-4	242.05	46.19	67.51	1.462	R
23-3	268.87	35.89	58.91	1.641	R
24-2	285.83	36.03	59.52	1.652	R
26-2	333.23	41.96	64.09	1.527	R
27-1	360.98	37.02	59.85	1.617	R
28-1	389.23	33.56	56.90	1.696	R
29-1	399.18	27.69	50.04	1.807	R
30-3	411.96	23.36	42.93	1.838	R
31-1	418.45	6.12	13.74	2.245	R
32-4	450.07	18.06	36.10	1.999	R
33-2	456.65	17.93	36.38	2.029	R

TABLE 1 – *Continued*

Core-Section	Sample Depth (m)	Water Content	Porosity	Wet Bulk Density	Sampling Technique
Hole 329 *Continued*					
33-3	458.06	16.34	33.46	2.048	R
33-4	459.98	7.79	17.63	2.262	R
33-4	460.72	18.65	38.01	2.038	R
Site 330					
1-1	130.18	42.44	–	–	R
1-3	133.43	38.80	63.25	1.630	R
1-4	135.21	44.99	69.20	1.538	R
1-6	138.05	34.83	58.91	1.691	R
2-2	178.80	29.96	53.51	1.786	R
2-2	179.03	33.35	57.01	1.709	R
2, CC	179.60	17.20	33.59	1.953	R
3-1	225.48	25.61	46.25	1.806	R
3-2	225.76	31.66	54.95	1.735	R
3-2	226.18	6.45	15.75	2.441	R
3-2	226.85	14.26	28.97	2.032	R
3, CC	227.10	10.30	22.41	2.176	R
4-1	272.75	2.84	6.94	2.449	R
4-2	274.38	26.39	48.13	1.824	S
5-2	302.39	22.30	40.84	1.831	S
5-2	302.82	25.00	46.33	1.853	R
5-3	303.03	3.10	8.05	2.600	R
5-3	303.52	24.42	45.45	1.861	R
5-3	303.82	2.79	7.19	2.576	R
5-3	303.87	4.25	10.98	2.587	R
5, CC	304.60	24.09	45.31	1.881	R
5, CC	304.60	25.36	46.60	1.838	R
6-4	314.37	23.65	44.72	1.891	R
6-5	316.07	23.15	44.09	1.905	R
6, CC	318.60	21.62	41.84	1.935	R
7-4	324.13	23.19	44.26	1.908	R
8-3	351.42	27.43	49.82	1.816	R
8-3	351.43	23.31	43.83	1.880	R
9-1	377.42	23.08	43.41	1.881	R
9-2	377.84	22.14	42.70	1.929	R
9-2	377.98	2.25	5.88	2.616	R
10-1	405.70	24.97	46.51	1.863	R
10-2	407.33	22.90	44.42	1.940	R
11-3	436.78	20.76	40.24	1.938	R
11-3	437.40	1.59	4.13	2.605	R
12-3	464.53	1.24	3.29	2.654	R
12-4	466.62	19.25	39.11	2.032	R
13-2	491.73	20.95	41.17	1.965	R
13-4	495.96	16.32	34.54	2.117	R
14-3	521.64	16.16	34.00	2.103	R
14-3	522.39	15.12	32.39	2.143	R
15-1	547.60	14.54	30.71	2.112	R
15-2	549.42	16.18	31.58	1.951	R
15-2	549.64	17.34	33.01	1.904	R
16-1	556.84	–	–	2.486	R
16-1	557.05	–	–	2.568	R
16-1	557.54	–	–	2.469	R
16-1	557.95	–	–	2.453	R
16-2	558.46	–	–	2.642	R
16-2	559.05	–	–	2.430	R
16-2	559.19	–	–	2.579	R
16-2	559.40	–	–	2.572	R
17-1	566.49	–	–	2.545	R
17-1	566.61	–	–	2.653	R
17-1	566.82	–	–	2.603	R
Site 331					
1-1	2.05	50.10	73.03	1.458	S
1-2	3.50	51.07	63.77	1.249	S
1-3	5.18	48.95	62.83	1.284	S
1-4	6.60	46.95	70.37	1.499	S
1-5	8.06	49.00	71.43	1.458	S
1-6	9.00	37.95	55.37	1.459	S

and porosity were calculated according to the following expressions (without salt corrections):

$$\text{Wet water content (\%)} = \frac{\text{(weight evaporated water)}}{\text{(weight wet sediment)}} \times 100$$

which is defined as the percent ratio between the weight of seawater in the sediment and the weight of the wet saturated sediment,

$$\text{Porosity (\%)} = \frac{(100) \quad \text{(weight evaporated water)}}{(1.0\ \text{g/cc}) \quad \text{(volume wet sediment)}}$$

and is defined as the percent ratio between the volume of the void space within the sediment and the volume of the wet saturated sample.

$$\text{Wet bulk density (g/cc)} = \frac{\text{weight wet sediment}}{\text{volume wet sediment}}$$

and is defined as the ratio between the weight of wet saturated sediments divided by its volume, and is expressed in g/cc.

It was found during the cruise that to minimize the inherent errors of this technique, the volume of sediments to be sampled with the syringe must be about 0.30 cc, but no less than 0.25 cc.

The weight of dry samples was determined in a precision balance after the extruded sediments were dried at 105°C for 24 hr and placed in a dessicator to cool for 2 hr.

Weight measurements of samples, particularly when small, have limited accuracy, particularly less under rough sea conditions. Unfortunately, weighing of samples obtained at Hole 327A was performed while sailing in heavy seas. It is estimated that errors in single weighing of samples amounted to about 7% to 10%. Under normal conditions, however, an average error of ±4% is expected when weighing small syringe samples.

The Rock "Chunk" Technique

This technique is utilized when the sediments recovered by drilling are too stiff to be sampled with a syringe. This is generally the case for the sediments recovered from the lower part of the sedimentary column. Samples of hard sediments and rocks were weighed wet and dry and their volumes determined by water displacement.

Gamma Ray Attenuation Techniques (Table 2)

Gamma Ray Attenuation Techniques are currently being used on a routine basis aboard *Glomar Challenger* and consist of passing the core immediately after recovery in its unsplit liner through the GRAPE apparatus (Gamma Ray Attenuation Porosity Evaluator). This equipment measures the intensity of a 3-mm-wide gamma ray passing through the sample. The output signal of the detector is processed and introduced into an analog recorder. The amplitude of the signal printed in the strip chart is linearly proportional to the bulk

TABLE 2
2-min GRAPE

Core-Section	Sample Depth (m)	Density
Hole 327A		
20-1	280.62	1.900
20-1	280.62	1.898
20-2	281.19	1.908
20-2	281.19	1.910
20-2	281.69	1.975
20-2	281.69	1.973
21-2	310.40	1.886
21-3	311.25	1.926
21-3	312.05	2.006
21-4	313.50	1.962
22-1	337.70	1.801
22-2	338.85	1.810
22-3	339.85	1.714
22-3	340.25	1.778
22-3	340.89	1.775
23-1	366.00	1.933
23-1	366.18	1.954
23-2	366.77	2.067
23-2	367.81	2.699
23-2	367.85	2.085
23, CC	368.10	1.894
23, CC	368.10	1.945
24-1	393.84	2.541
24-1	394.09	2.011
24-1	394.28	2.160
24-2	395.25	1.870
24-2	396.23	1.775
24-2	396.40	2.301
24-2	396.41	2.428
25-1	422.81	2.365
25-2	424.95	2.119
25-3	426.46	1.982
26-1	451.63	1.976
26-2	453.34	2.039
27-1	460.82	2.313
Hole 328B		
7-1	435.68	1.885
7-1	435.68	1.871
7-2	437.58	1.857
7-2	437.58	1.823
7-3	439.67	1.826
7-4	441.36	1.865
7-4	441.36	1.858
7-5	442.20	1.936
7-6	443.17	1.842
7-6	444.00	1.956
7, CC	444.60	1.981
7, CC	444.60	1.964
Site 329		
20, CC	198.60	1.679
20, CC	198.60	1.449
22-2	238.22	1.340
22-2	238.22	1.335
22-2	239.45	1.406
22-2	239.47	1.391
22-2	239.47	1.384
22-3	240.45	1.441
22-3	240.46	1.307
22-3	240.46	1.322
22-4	242.05	1.432
22-4	242.05	1.471
23-1	266.40	1.853
23-2	267.45	1.855

TABLE 2 – *Continued*

Core-Section	Sample Depth	Density
Site 329 *Cont.*		
23-3	268.15	1.669
23-3	268.87	1.650
24-2	285.83	1.669
24-2	285.83	1.685
24-2	285.90	1.872
24-3	287.38	1.692
26-1	332.35	1.507
26-2	333.23	1.529
26-2	333.23	1.554
26-2	333.85	1.476
27-1	360.98	1.663
27-1	360.98	1.612
28-1	389.23	1.760
28-1	389.23	1.761
29-1	399.18	1.839
29-1	399.18	1.831
30-2	409.54	1.969
30-3	410.85	1.895
30-3	411.96	1.884
30-3	411.96	1.813
31-1	418.45	2.251
31-1	418.45	2.270
32-4	450.70	2.110
32-4	450.70	2.118
33-2	456.65	2.033
33-2	456.65	2.063
33-3	458.06	2.095
33-3	458.06	2.110
33-3	458.22	2.354
33-4	459.98	2.226
33-4	459.98	2.277
33-4	460.65	2.404
33-4	460.72	2.084
33-4	460.72	2.097
Site 330		
1-1	130.15	1.754
1-3	133.43	1.716
1-4	135.21	1.568
1-6	138.05	1.694
1-6	138.05	1.722
2-2	178.80	1.803
2-2	179.03	1.713
2, CC	179.60	2.660
2, CC	179.60	2.468
2, CC	179.60	3.130
3-1	225.48	1.757
3-2	225.76	1.650
3-2	226.18	2.357
3-2	226.18	2.438
3-2	226.85	2.094
3, CC	227.10	2.005
3, CC	227.10	2.041
4-1	273.05	3.434
4-1	273.05	1.956
5-2	302.82	1.894
5-2	302.82	1.890
5-3	303.03	2.694
5-3	303.52	1.856
5-3	303.82	2.692
5-3	303.87	2.548
5-3	303.87	2.492
5, CC	304.60	1.920
6-4	314.37	1.929
6-5	316.07	1.916
6, CC	318.60	1.947

TABLE 2 – *Continued*

Core-Section	Sample Depth (m)	Density
Site 330 *Cont.*		
7-4	324.13	1.898
8-3	351.43	1.794
8-3	351.43	1.890
9-1	377.42	1.921
9-2	377.84	1.926
9-2	377.84	1.916
9-2	377.98	2.647
10-2	406.25	2.052
10-2	407.05	2.172
10-2	407.33	1.948
11-2	434.75	1.998
11-3	436.78	1.911
11-3	436.78	1.930
11-3	437.40	2.757
11-5	439.78	3.003
12-3	464.53	2.649
12-4	466.62	1.931
13-1	490.85	2.142
15-1	547.25	2.090
15-1	547.60	2.097
15-1	548.11	2.118
15-2	548.73	2.060
15-2	549.42	1.860
15-2	549.42	1.831
15-2	549.49	1.844
15-2	549.64	1.672
15, CC	550.10	2.705
16-1	556.50	2.457
16-1	556.50	2.380
16-1	556.50	2.401
16-1	556.60	2.568
16-2	558.00	2.649
16-2	558.00	2.406
16-2	558.00	2.528
16-2	558.00	2.627
16-2	559.20	2.636
17-1	566.00	2.516
17-1	566.00	2.659
17-1	566.00	2.588
17-2	567.50	2.674
17-2	568.40	2.470
17-2	568.95	2.550
17-3	569.71	2.538
17, CC	570.60	2.678

density of the sample, relative to reference standard signals used for calibration of the scale. The standards used for comparison consist of empty 2.6-in I. D. plastic liners and aluminum cylinders of 2.6 and 1.0 in. diameter which are run through the system before and after each set of measurements on sediments and rocks is performed.

When measuring unsplit samples in their liners, the portion of the core sampled moves across the gamma ray in about 2 sec. As a 2-sec period has low precision, these routine data were used only as a basis for general correlation of physical parameters or when more precise measurements in hard sediments or rocks were not available. Otherwise, and in order to obtain more precise information on samples processed in conjunction with sonic compressional velocity measurements, individual samples were run for 2 min, and later their water content measured to determine porosity in addition to bulk densities.

Although the GRAPE system is capable of measuring wet bulk density to about ±10% for each 2-sec counting period, the accuracy of the system is hampered by difficulties encountered in determining the real thickness of the sample exposed to the gamma ray. The analog GRAPE data are technically accurate when soft sediment completely fills the liner (although the sediment is probably disturbed). When stiff sediments or rocks are encountered, their diameters are smaller than the liners and therefore their diameters should be measured (although they are very rough and grooved). In addition, it must be noted whether they are surrounded by sediment, slurry, paste, water, or air. The sediment, slurry, or paste must have its density measured to make the proper adjustments. In addition, if the hard sediment or rock core is lying to one side of the liner, then the offset of the rock core's diameter from the axis of the gamma ray beam must also be measured (Boyce, 1973, 1976). If all of these parameters are measured, then it is possible to adjust the analog GRAPE data for stiff sediment and rocks for their actual gamma ray path length through the core samples. However the preceding parameters were inadvertently not measured during Leg 36, therefore hard rocks may have density errors ranging from 2% to 12%. The average error for density can be on the order of 2% to 5% for misalignments of only 1 mm in samples with a diameter ranging from 6 to 2 cm, respectively.

The analog GRAPE data (±11%) and 2-min GRAPE data (±2%) were processed by equations in Boyce (1976), however, adjustments of the analog data for geometric problems were not made. Therefore, approximated "True" wet bulk density values were calculated from the Evans (1965) "corrected" wet bulk density values. The variables used in these equations are as follows: for sediments a true grain density of 2.60 g/cc, a "corrected" grain density of 2.60 g/cc, a true fluid density of 1.025 g/cc, and a "corrected" fluid density of 1.128 g/cc. These equations adjust for the anomalous fluid density of seawater and assume the grains have a quartz attenuation coefficient.

Standards of aluminum (true density = 2.71 g/cc) were used with both the analog GRAPE data and 2-min GRAPE counts. For the analog data the 6.61-cm aluminum standard was assigned a density value of 2.60 g/cc, and the 2.54 cm aluminum standard was assigned a value of 1.03 g/cc as discussed in Boyce (1976). For the 2-min density data an attenuation coefficient for each sample was determined by a linear interpolation between 0.10432 cm^2/g and 0.10838 cm^2/g for 6.61 and 2.54 cm aluminum standards. This interpolation was made based on the thickness of the same, which is discussed in detail in Boyce (1976).

Leg 36 2-min techniques varied from Boyce (1976) where Leg 36 did not use a new air gamma count with every gamma count through the sample. This will result in an unusual statistical variation in any potential scatter diagram.

SONIC COMPRESSIONAL VELOCITY (TABLE 3)

In situ and laboratory determinations of sonic compressional velocities for marine sediments were started nearly 20 yr ago (Laughton, 1954, 1957; Hamilton, 1956; Sutton et al., 1957). Since then, numerous observations of the velocity structure of the sea floor have been undertaken using indirect geophysical methods (seismic wide-angle reflection and refraction) in most regions of the world's oceans, and these data have been related to other mass physical properties of surface sediments (e.g., Nafe and Drake, 1957, 1963). However, it was not until the first deepsea drilling of the ocean was instrumented through the MOHOLE experiment (Guadalupe site), with samples retrieved and measured (Hamilton, 1969), that geologists and geophysicists had the opportunity to test earlier speculations on the nature and properties of deep-seated lithological units.

Because of the important role played by the knowledge of the velocity of sound through deep ocean sediments for its application in seismic reflection and refraction studies, future correlations, and predictions of the position of acoustic lithological units while drilling with regard to operational safety or for scientific reasons, compressional velocities will be always measured aboard *Glomar Challenger* in an effort to sample velocities of at least every major lithological unit downhole and to relate them with water content, bulk and grain density, carbon carbonate content, porosity, and X-ray mineralogy measurements in samples taken from the same intervals along the core.

The velocity of sound through soft and hard sediments and rocks was determined using a sound source operating at 400 kHz. Measurements were taken with the samples at atmospheric pressure and at temperatures ranging from 18°C to 25°C with a few sections measured at 15°C.

The instruments used for measuring sonic velocity onboard *Glomar Challenger* during the cruise was the Hamilton frame system which was first utilized in 1970 during Leg 15. The principle of operation is based on the accurate measurement of travel time of sound across the sediment or rock samples with simultaneous measurement of the travel distance involved. This is accomplished by placing the sample in close contact with a pair of transducers (one sending, the other receiving) after the best possible impedance matching has been achieved between sample and transducers. The difference between successive readings of a Dial Micrometer when the barium-titanite transducers are in close contact (relative "zero" distance) and when the sample is placed between the transducers is then recorded as the travel distance. Under favorable conditions (small ship vibrations and sea states 1 to 3), it was possible to obtain reliable readings close to 0.5 μm. The average thickness of the samples ranged between 2 and 4 cm. The travel time across the sample is measured in a similar way by recording the differences between the relative travel time at zero separation of the transducers and the travel time of the pulse across the sample, as registered in a calibrated dial (μsec) of the oscilloscope. The beginning of the wave train is aligned in both cases with the center vertical grid line of the scope face. Extreme care must be taken in measuring travel time, which in fact is the main source of error of the system, as it mainly depends on the proper alignment of the breaking point of the wave front which is often not sharp enough to be detected on weak signals. Thus, the measurement is affected by a subjective choice from among several possibilities.

Calibration of the time delay measurement system is often checked onboard, and eventual correction factors are taken into account when processing the data. During Leg 34 an exhaustive empirical check of the electronics was undertaken, by repetitive measurements performed on plexiglas and aluminum standards of known velocity, and the corrections so obtained were also used during Leg 36. The corrections mentioned above are as follows:

μsec/cm Scope Dial	Velocity Range	True Velocity
1.0	all	Measured velocity × 1.0093
2.0	< 3 km/sec	Measured velocity × 1.011
	> 3 km/sec	Measured velocity × 1.037
5.0	< 3 km/sec	Measured velocity × 0.988
	> 3 km/sec	Measured velocity × 1.008
10.0	> 3 km/sec	Measured velocity × 0.991
	< 3 km/sec	Measured velocity × 1.013

With the present system installed onboard it is possible, in most cases, to determine sonic velocities of soft and hard sediments and of rocks representative of every lithological unit encountered, provided the samples have been properly prepared. In a few cases, however, the level of the detected acoustic signal transmitted through the sample is too small to be measured with the present configuration or is just above the critical level. The sonic velocities so obtained are in gross error. This condition is found when there is a mismatch of the sample with the transducers (in perfect leveling of the sample faces and poor contact of the active surfaces), or more rarely so, for samples exhibiting physical properties of a particular nature (sediments gassy or rich in fossil plant debris, or with very low water content). In practice, particularly during periods of intensive coring, the time available does not permit successive corrective machining of each hard rock or consolidated sediment to obtain parallel faces and smooth surfaces. In other instances, hard sediments are brittle and successive scraping often destroys the sample. These limitations bear on the accuracy of only a certain percentage of the total sampling, but in many cases may include very old or basal sediments for which this information is highly desirable. If the present system is modified to increase its present maximum signal out of the sound source or the overall gain of the detected signal is increased, a general improvement in the accuracy and density of data is anticipated.

When the sediments were too soft to be handled out of the core liner, sonic velocities were measured by placing the longitudinally split core liner between the transducer pair. As the sound travels across two different media, thickness of the liner and travel time across it were calculated by measuring several sections of plastic liner independently, and the average values so determined were always subtracted from the thickness and travel time determined for the sediments measured in the liners, the corrections obtained were as follows: average liner thickness: 2.3 mm, average time across the liner: 1.2 μsec.

TABLE 3
Sonic Velocity

Core-Section	Sample Depth (m)	Velocity	Orientation[a]
1-2	5.78	1.722	
1-3	7.42	1.610	
1-3	7.51	1.614	
1-3	8.10	1.798	
2-1	14.48	1.579	
2-2	16.22	1.565	
2-3	17.01	1.847	
2-4	18.38	1.555	
2-4	18.38	1.576	
2-4	19.00	1.571	
2-5	19.98	1.573	
2-5	20.50	1.576	
5-5	49.50	1.537	
6-4	57.10	1.538	
8-3	74.50	1.524	
9-6	88.35	1.527	
9-6	88.80	1.530	
9-6	89.07	1.516	
9-6	89.07	1.532	
10-1	90.54	2.240	
10-1	90.54	2.186	
10-1	90.54	2.212	
10-1	90.88	2.265	
10-1	90.88	2.282	
10-1	90.88	2.263	
10-3	92.89	1.572	
10-3	93.50	1.557	
11-1	99.42	1.530	
11-1	99.42	1.536	
11-1	99.61	1.551	
11-1	100.15	4.127	
11-1	100.15	4.088	
11-1	100.15	4.138	
11-1	100.44	1.544	
12-2	110.15	1.560	
12-2	110.95	1.555	
12-4	113.30	1.575	
12-4	114.17	1.595	
13-2	139.48	1.630	
13-2	139.48	1.632	
14-1	147.74	1.580	
14-1	147.84	1.577	
14-2	148.58	1.589	
14-2	148.97	1.584	
14-2	148.97	1.588	
14-3	150.74	1.579	
14-4	152.18	1.600	
14-5	153.05	1.590	
14-5	153.05	1.594	
14-6	154.67	1.664	
14-6	154.97	1.628	
14-6	154.97	1.668	
14-6	155.42	1.669	
14-6	155.42	1.687	
14-6	155.42	1.671	
15-2	177.60	1.645	
15-2	177.20	1.645	
16-1	185.08	1.579	
16-1	185.60	1.629	
16-1	185.60	1.635	
16-2	186.49	1.680	
16-2	187.24	1.612	
16-3	188.05	1.698	
16-3	188.05	1.696	
16-4	189.55	1.612	
16-5	191.60	1.487	

TABLE 3 – *Continued*

Core-Section	Sample Depth (m)	Velocity	Orientation[a]
16-5	191.60	1.630	
16-6	192.31	1.614	
16-6	192.75	1.706	
17-2	215.81	1.601	
17-2	215.81	1.613	
18-1	223.51	1.817	
18-1	223.51	1.827	
18-1	223.51	1.834	
18-1	223.51	1.827	
18-1	224.09	1.735	
18-1	224.09	1.724	
18-1	224.09	1.731	
18-1	224.09	1.731	
18-2	224.98	1.738	
18-2	224.98	1.751	
18-2	224.98	1.702	
18-2	225.59	1.721	
18-3	226.58	1.805	
18-3	226.58	1.822	
18-4	227.91	1.868	
18-4	227.91	1.844	
18-4	228.59	1.750	
18-4	228.59	1.807	
18-4	228.59	1.809	
18-5	229.20	1.763	
18-5	229.20	1.790	
18-6	231.32	1.851	
18-6	231.35	1.889	
18-6	231.32	1.852	
18-6	231.32	1.896	
19-1	251.88	1.748	
19-1	251.88	1.735	
19-1	251.88	1.736	
19-2	253.17	1.758	
19-2	253.17	1.749	
19-2	253.17	1.753	
19-2	253.17	1.736	
19-2	253.17	1.745	
20-1	280.70	1.850	
20-1	280.70	1.854	
20-1	280.70	1.864	
20-1	280.70	1.872	
20-2	281.72	1.836	
20-2	281.72	1.819	
20-2	281.72	1.818	
20-2	281.72	1.808	
20-2	281.72	1.813	
21-2	310.44	1.875	
21-2	310.44	1.894	
21-2	310.44	1.856	
21-2	310.44	1.859	
21-2	310.44	1.896	
21-3	312.06	1.975	
21-3	312.06	1.990	
21-3	312.06	1.964	
21-3	312.06	1.990	
21-3	312.06	1.959	
21-3	312.06	1.964	
21-3	312.29	1.867	
21-3	312.29	1.875	
21-3	312.29	1.880	
21-3	312.29	1.879	
21-3	312.29	1.886	
21-3	312.29	1.873	
21-4	313.42	1.859	
21-4	313.42	1.856	
21-4	313.42	1.832	
21-4	313.42	1.850	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation[a]
Hole 327A *Continued*			
21-4	313.42	1.848	
21-4	313.42	1.837	
22-1	337.52	2.204	
22-1	337.52	2.244	
22-1	337.52	2.258	
22-1	337.52	2.276	
22-1	337.72	2.041	
22-1	337.72	2.001	
22-1	337.72	2.014	
22-1	337.72	2.021	
22-2	338.31	2.368	
22-2	338.31	2.368	
22-2	338.31	2.350	
22-2	338.31	2.372	
22-2	338.50	2.645	
22-2	338.50	2.644	
22-2	338.50	2.644	
22-2	338.93	2.784	
22-2	338.93	2.773	
22-2	338.92	2.794	
22-3	339.90	2.097	
22-3	339.90	2.114	
22-3	339.90	2.091	
22-3	339.90	2.117	
22-3	340.89	2.590	
22-3	340.89	2.552	
22-3	340.89	2.740	
22-3	340.89	2.671	
22-3	340.89	2.679	
22-3	340.89	2.609	
23-1	366.00	2.286	
23-1	366.00	2.283	
23-1	366.00	2.279	
23-2	367.70	2.305	
23-2	367.70	2.315	
23-2	367.81	4.421	
23-2	367.81	4.312	
23-7	374.00	2.278	H
23-7	374.00	2.252	H
23-7	374.00	2.278	H
23-7	374.00	2.249	H
23-7	374.00	2.127	V
23-7	374.00	2.136	V
23-7	374.00	2.151	V
23-7	374.00	2.120	V
23-7	374.00	2.101	V
23-7	374.00	2.114	V
23-7	374.00	2.112	V
23-7	374.00	2.108	V
24-1	393.84	3.893	
24-1	393.84	3.950	
24-1	393.84	3.838	
24-1	393.84	3.883	
24-1	394.28	2.761	
24-1	394.28	2.736	
24-2	395.23	2.037	
24-2	395.23	2.011	
24-2	395.23	2.023	
24-2	396.22	1.893	
24-2	396.42	3.083	
24-2	396.42	3.484	
24-2	396.42	3.126	
24-2	397.42	3.403	
24-2	396.42	3.386	
24-2	396.42	3.236	
24-2	396.42	3.236	
24-2	396.42	3.088	
25-1	422.84	3.573	
25-1	422.84	3.674	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation[a]
Hole 327A *Continued*			
25-1	422.84	3.721	
25-2	424.95	2.273	
25-2	424.95	2.486	
25-2	424.95	2.251	
25-3	426.47	2.011	
25-3	426.47	2.040	
25-3	426.47	2.009	
25-3	426.47	1.999	
26-1	451.60	1.877	
26-1	451.60	1.876	
26-1	451.60	1.873	
26-2	453.34	1.847	
26-2	453.34	1.861	
27-1	460.75	2.963	
27-1	460.75	3.150	
27-1	460.75	3.084	
27-1	460.75	3.072	
Hole 328			
1-1	1.12	1.623	
1-1	1.22	1.611	
1-1	1.22	1.601	
1-2	2.00	1.520	
1-2	2.00	1.523	
1-2	2.88	1.592	
1-3	4.10	1.534	
1-4	5.24	1.509	
1-5	7.20	1.534	
2-4	13.24	1.540	
2-4	13.24	1.540	
2-4	13.24	1.536	
3-1	17.50	1.516	
3-1	18.07	1.504	
3-2	19.76	1.520	
3-3	20.33	1.507	
3-3	20.95	1.516	
3-3	20.95	1.522	
3-4	21.77	1.515	
3-4	21.77	1.519	
3-4	22.25	1.521	
3-4	22.25	1.522	
3-5	23.27	1.524	
3-5	23.75	1.539	
3-5	24.42	1.543	
3-6	24.93	1.561	
3-6	25.66	1.530	
4-2	47.78	1.493	
4-2	48.26	1.511	
4-4	50.18	1.520	
5-2	94.77	1.513	
5-2	95.40	1.505	
5-3	96.37	1.501	
6-1	141.32	1.540	
6-1	141.32	1.538	
6-2	142.41	1.539	
6-2	143.01	1.540	
6-2	143.01	1.542	
6-3	144.00	1.524	
6-3	144.00	1.525	
7-4	193.88	1.541	
7-4	193.88	1.548	
9-7	292.30	1.582	
10-1	330.81	1.580	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Hole 328 *Continued*			
10-1	330.81	1.576	
10-1	330.81	1.560	
10-1	330.81	1.576	
10-1	330.81	1.560	
10-1	330.90	1.729	
10-1	330.90	1.721	
10-7	339.50	1.665	
10-7	339.50	1.697	
11-1	359.59	1.854	
11-1	359.59	1.846	
11-1	359.59	1.843	
11-1	359.75	1.846	
11-1	359.75	1.858	
11-1	359.75	1.824	
11-1	360.15	1.800	
11-3	362.68	1.673	
11-3	362.68	1.675	
11-3	362.97	1.753	
11-3	362.97	1.730	
11-3	363.95	1.750	
11-3	363.25	1.795	
11-3	363.25	1.789	
11-3	363.25	1.763	
11-4	363.60	1.688	
11-4	363.60	1.699	
11-4	364.38	1.837	
11-4	364.38	1.839	
11-4	364.58	1.721	
11-4	364.58	1.720	
11-5	365.59	1.706	
11-5	365.98	1.718	
11-6	366.72	1.673	
11-6	366.72	1.677	
11-6	367.35	1.691	
11-6	367.35	1.690	
11-6	367.89	1.699	
12-1	387.67	1.902	
12-1	388.06	1.923	
12-1	388.06	1.824	
12-1	388.45	1.965	V
12-1	388.45	1.985	V
12-1	388.45	2.148	H
12-1	388.45	2.151	H
12-1	388.45	2.126	H
12-1	388.76	1.941	
12-1	388.76	1.948	
12-2	389.17	1.833	
12-2	389.17	1.831	
12-2	389.17	1.822	
12-2	389.17	1.836	
12-6	396.00	1.787	
12-6	396.00	1.779	
12-6	396.20	1.825	H
12-6	396.20	1.825	H
12-6	396.20	1.822	H
12-6	396.20	1.745	V
12-6	396.20	1.732	V
12-6	396.20	1.735	V
Hole 328B			
1-2	9.68	1.539	
1-2	9.68	1.535	
1-3	11.23	1.540	
1-3	11.23	1.538	
1-4	12.94	1.547	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Hole 328B *Continued*			
1-4	12.94	1.543	
1-5	14.25	1.517	
1-5	14.22	1.522	
1-6	15.66	1.528	
1-6	15.66	1.535	
1-1	8.80	1.576	
1-1	8.80	1.612	
2-1	17.68	1.522	
2-1	17.68	1.522	
2-2	19.52	1.530	
2-2	19.52	1.523	
2-3	21.43	1.544	
2-3	21.43	1.544	
2-4	22.67	1.536	
2-4	22.67	1.535	
2-5	24.18	1.554	
2-5	24.18	1.554	
2-6	25.26	1.552	
2-6	25.26	1.559	
2-6	25.95	1.549	
2-6	25.95	1.551	
3-1	27.65	1.548	
3-1	27.65	1.553	
3-1	28.13	1.538	
3-1	28.13	1.536	
3-2	29.18	1.552	
3-2	29.18	1.549	
3-3	30.75	1.530	
3-3	30.75	1.535	
3-3	30.75	1.532	
3-4	32.16	1.531	
3-4	32.16	1.536	
3-5	33.40	1.516	
3-5	33.40	1.525	
3-6	35.20	1.942	
3-6	35.20	1.952	
3-6	35.36	1.925	
3-6	35.36	1.957	
4-1	36.76	1.510	
4-1	36.76	1.506	
4-1	37.10	1.513	
4-1	37.10	1.503	
4-2	38.83	1.510	
4-2	38.83	1.505	
4-4	41.18	1.520	
4-4	41.18	1.522	
4-5	42.98	1.528	
4-5	42.98	1.525	
5-1	46.40	1.514	
5-1	46.40	1.521	
5-1	46.80	1.516	
5-1	46.80	1.507	
5-1	47.21	1.514	
5-1	47.21	1.507	
5-2	48.16	1.506	
5-2	48.16	1.510	
5-3	49.30	1.509	
5-3	49.30	1.515	
5-3	50.07	1.510	
5-3	50.07	1.506	
5-4	50.75	1.516	
5-4	50.75	1.514	
5-5	52.27	1.517	
5-5	52.27	1.512	
5-5	53.07	1.510	
5-6	53.84	1.518	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Hole 328B *Continued*			
5-6	53.84	1.516	
6-1	55.81	1.517	
6-2	57.28	1.509	
6-3	58.68	1.503	
6-4	60.28	1.503	
6-5	61.75	1.506	
6-6	63.21	1.506	
6-6	63.21	1.511	
7-1	435.68	1.747	
7-1	435.68	1.742	
7-2	437.58	1.747	
7-2	437.58	1.751	
7-3	439.67	1.730	
7-3	439.67	1.733	
7-4	441.36	1.735	
7-5	441.57	1.918	
7-5	441.57	1.919	
7-6	444.00	1.927	
7-6	444.00	1.927	
7-6	443.17	1.710	
7-7	444.50	1.783	
7-7	444.50	1.775	
7-7	444.50	1.807	
7-7	444.50	1.795	
7-7	444.50	1.810	
7-7	444.50	1.798	
7-7	444.50	1.806	
7-7	444.50	1.796	
7-7	444.50	1.822	
7-7	444.50	1.819	
7-7	444.50	1.808	
7-7	444.50	1.792	
8-1	472.27	1.937	
8-1	472.27	1.934	
Site 329			
1-2	2.38	1.694	
1-3	3.59	1.600	
1-4	4.81	1.553	
1-5	7.17	1.546	
1-6	7.88	1.551	
2-1	9.92	1.563	
2-1	9.92	1.568	
2-3	12.60	1.584	
2-3	12.60	1.541	
2-4	13.35	1.582	
2-4	13.35	1.575	
2-4	14.39	1.538	
2-4	14.39	1.433	
2-5	15.26	1.538	
2-5	15.26	1.544	
2-5	15.26	1.548	
2-6	16.33	1.549	
2-6	16.33	1.557	
2-6	16.89	1.536	
3-1	18.60	1.542	
3-1	18.60	1.546	
3-2	20.72	1.524	
3-2	20.72	1.535	
3-3	21.50	1.486	
3-3	21.50	1.492	
3-3	22.33	1.492	
3-3	22.13	1.497	
3-3	22.13	1.497	
3-4	23.13	1.460	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Site 329 *Continued*			
5-6	44.83	1.549	
5-6	44.83	1.550	
5-6	44.83	1.552	
5-6	44.83	1.554	
5-6	44.83	1.551	
8-5	72.12	1.518	
8-5	72.12	1.520	
8-6	74.32	1.552	
8-6	74.32	1.538	
10-1	85.21	1.534	
10-1	85.21	1.548	
10-1	85.21	1.535	
10-4	89.94	1.535	
10-4	89.94	1.535	
10-5	91.26	1.532	
10-5	91.26	1.535	
10-6	93.01	1.538	
10-6	93.01	1.529	
11-1	95.35	1.539	
11-1	95.35	1.541	
11-2	96.40	1.525	
11-2	96.40	1.538	
11-3	97.81	1.526	
11-3	97.81	1.531	
11-4	99.16	1.446	
11-6	102.10	1.536	
12-1	104.79	1.519	
12-2	105.74	1.536	
12-2	105.74	1.534	
12-3	107.64	1.534	
12-4	109.33	1.506	
12-5	110.89	1.536	
12-6	112.88	1.537	
13-1	114.28	1.537	
13-2	115.79	1.552	
13-3	116.88	1.537	
13-4	118.76	1.545	
13-5	120.07	1.545	
13-6	121.78	1.540	
14-1	123.94	1.546	
14-2	125.58	1.547	
14-3	126.50	1.558	
14-4	128.33	1.551	
14-5	129.27	1.543	
14-6	131.76	1.535	
15-1	133.44	1.517	
15-2	134.66	1.525	
15-3	136.65	1.522	
15-4	137.94	1.523	
15-5	139.28	1.522	
15-6	140.27	1.527	
16-1	142.86	1.536	
16-2	144.75	1.538	
16-3	145.64	1.533	
16-4	147.01	1.534	
16-5	148.82	1.524	
16-6	150.37	1.539	
17-1	152.25	1.533	
17-2	153.57	1.538	
17-3	154.98	1.533	
17-4	156.43	1.529	
17-5	158.70	1.533	
17-6	160.08	1.524	
18-1	161.38	1.531	
18-2	163.03	1.533	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Site 329 *Continued*			
18-3	164.42	1.531	
18-4	165.93	1.530	
18-5	167.34	1.532	
18-6	169.63	1.533	
19-1	171.07	1.533	
19-2	171.92	1.532	
19-3	173.52	1.542	
19-4	174.81	1.534	
20-1	190.17	1.550	
20-2	191.32	1.541	
20-3	193.82	1.533	
20-4	194.43	1.553	
20-5	196.42	1.546	
20-6	197.32	1.543	
20-7	198.50	1.520	V
20-7	198.50	1.520	H
20-7	198.50	1.517	H
21-3	212.20	1.543	
21-3	211.71	1.551	
21-4	212.69	1.540	
21-4	213.23	1.542	
22-2	239.47	1.551	
22-3	240.46	1.589	H
22-3	240.46	1.593	V
22-4	242.05	1.580	
22-2	238.22	1.605	
23-2	267.37	1.618	
23-2	267.37	1.587	
23-2	267.37	1.598	
24-2	285.83	1.559	V
24-2	285.83	1.568	V
24-2	285.83	1.593	H
24-2	285.83	1.593	H
26-2	333.23	1.603	H
26-2	333.23	1.598	H
26-2	333.23	1.580	V
26-2	333.23	1.592	V
27-1	360.98	1.654	V
27-1	360.98	1.650	V
27-1	360.98	1.656	H
27-1	360.98	1.661	H
28-1	389.23	1.708	H
28-1	389.23	1.703	H
28-1	389.23	1.662	V
28-1	389.23	1.663	V
29-1	399.18	1.708	V
29-1	399.18	1.730	V
29-1	399.18	1.730	H
29-1	399.18	1.756	H
30-3	411.96	1.756	H
30-3	411.96	1.754	H
30-3	411.96	1.730	H
30-3	411.96	1.727	H
30-3	411.96	1.760	H
30-3	411.96	1.748	
31-1	418.45	4.071	H
31-1	418.45	4.128	H
31-1	418.45	4.102	H
31-1	418.45	3.746	V
31-1	418.45	3.716	V
32-4	450.07	2.174	V
32-4	450.07	2.192	V
32-4	451.38	2.072	H
32-4	451.38	2.086	H
32-4	450.07	2.198	H
32-4	450.07	2.214	H

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Site 329 *Continued*			
33-2	456.65	2.224	H
33-2	456.65	2.253	H
33-2	456.65	2.172	V
33-2	456.65	2.159	V
33-3	458.06	2.240	V
33-3	458.06	2.240	V
33-3	458.24	2.241	H
33-3	458.06	2.262	H
33-4	459.98	3.385	H
33-4	459.98	3.385	H
33-4	459.98	2.065	H
33-4	459.98	3.210	V
33-4	459.98	3.248	V
33-4	459.98	3.250	V
33-4	460.72	1.999	V
33-4	460.72	2.007	V
33-4	460.72	2.056	H
Site 330			
1-7	138.50	1.614	
1-1	130.18	1.654	
1-3	133.43	1.622	
1-4	135.21	1.583	
1-6	138.05	1.653	
2-2	178.80	1.715	
2-2	178.80	1.719	
2-2	179.03	1.698	
2-2	179.03	1.743	
2-2	179.03	1.753	
2-7	185.50	2.555	V
2-7	185.50	2.580	V
2-7	185.50	2.572	V
2-7	185.50	2.586	V
2-7	185.50	2.564	V
3-1	225.48	2.100	
3-2	225.76	1.943	
3-2	225.76	1.944	
3-2	226.18	3.685	
3-2	226.18	3.709	
3-2	226.85	3.062	
3-2	226.85	3.107	
3-7	233.00	2.623	V
3-7	233.00	2.623	V
3-7	233.00	3.101	H
3-7	233.00	3.093	H
4-1	272.75	4.711	H
4-1	272.75	4.772	H
4-1	272.75	4.831	H
4-1	272.75	4.740	H
4-1	272.75	4.729	H
4-1	272.75	4.600	V
4-1	272.75	4.621	V
4-1	272.75	4.628	V
4-1	272.75	4.586	V
4-1	272.75	4.545	V
4-1	272.75	4.559	V
4-2	274.38	1.606	
4-2	274.38	1.604	
5-2	302.82	1.631	V
5-2	302.82	1.637	V
5-2	302.82	1.731	H
5-2	302.82	1.733	H
5-3	303.87	3.953	
5-3	303.87	3.859	
5-3	303.82	4.914	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Site 330 *Continued*			
5-3	303.82	5.015	
5-3	303.03	4.419	
5-3	303.03	4.467	
5-3	303.52	1.733	
5-7	309.00	1.781	
6-4	314.37	1.779	H
6-4	314.37	1.655	V
6-7	318.50	1.888	
6-7	318.50	1.867	
6-5	316.07	1.811	
7-7	328.00	1.696	
7-4	324.13	1.776	
8-3	351.42	1.825	
9-1	377.42	1.853	
9-1	377.42	1.853	
9-2	377.84	1.842	
9-2	377.84	1.838	
9-2	377.98	5.589	
9-2	377.98	4.858	
9-2	377.98	4.804	
9-2	377.98	5.418	
9-2	377.98	5.547	
9-2	377.98	5.002	
10-1	405.25	4.290	
10-1	405.25	4.310	
10-1	405.70	1.804	
10-2	407.33	1.885	
10-2	407.33	1.943	
10-2	406.20	1.890	
11-1	433.53	1.806	
11-3	436.78	2.463	
11-3	436.78	3.219	
11-3	436.78	2.534	
11-3	436.78	3.340	
11-3	436.78	1.749	
11-3	436.78	1.774	
11-3	437.40	5.221	
11-3	437.40	5.427	
11-3	437.40	5.434	
11-6	441.95	5.054	
11-6	441.95	5.086	
11-6	441.95	5.109	
11-6	441.95	5.137	
11-6	441.95	5.064	
12-3	465.01	1.809	
12-4	466.62	1.797	
12-4	466.62	1.828	
12-3	464.53	5.229	
12-3	464.53	5.256	
12-7	470.50	4.918	
13-4	495.96	1.836	
13-4	495.96	1.828	
13-2	491.73	1.743	
13-2	491.73	1.766	
14-3	521.64	1.830	
14-3	521.64	1.781	
15-1	547.60	2.044	
15-1	547.60	2.073	
15-1	547.60	2.099	
15-1	547.60	2.143	
15-2	549.64	1.977	
15-7	556.00	5.261	
15-7	556.00	5.261	
15-7	556.00	5.284	
16-1	556.50	5.490	
16-1	556.50	5.487	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Site 330 *Continued*			
16-1	556.80	4.195	
16-1	556.80	4.156	
16-1	556.80	4.172	
16-1	557.03	5.100	
16-1	557.03	5.280	
16-1	557.03	4.950	
16-1	557.50	3.977	
16-1	557.50	3.885	
16-1	557.50	4.007	
16-1	557.93	3.181	
16-1	557.93	3.155	
16-1	557.93	3.090	
16-1	557.50	4.186	
16-1	557.50	4.289	
16-1	557.50	4.371	
16-1	557.50	4.309	
16-1	557.50	3.961	
16-1	557.50	4.288	
16-1	557.50	4.287	
16-1	557.50	4.343	
16-2	559.03	2.443	V
16-2	559.03	2.498	V
16-2	559.03	2.406	V
16-2	559.45	2.817	V
16-2	559.45	4.763	V
16-2	559.45	4.817	V
16-2	559.45	4.952	V
16-2	559.50	5.350	
16-2	558.43	5.052	
16-2	558.43	5.272	
16-2	558.43	5.151	
16-2	559.16	3.653	
16-2	559.16	3.831	
16-2	559.16	3.538	
16-2	559.36	4.282	
16-2	559.36	4.236	
16-2	559.36	4.175	
16-2	559.45	5.285	
16-2	559.45	5.306	
16-2	559.45	5.278	
16-2	559.45	5.336	
16-2	559.45	5.304	
16-2	559.45	5.314	
16-2	559.45	5.352	
17-1	566.45	4.512	
17-1	566.45	4.122	
17-1	566.45	4.387	
17-1	566.79	4.850	
17-1	566.79	5.015	
17-1	566.79	5.019	
17-1	566.58	4.451	
17-1	566.58	4.845	
17-1	566.58	4.893	
17-1	566.58	4.785	
17-1	566.79	5.351	
17-1	566.79	5.001	
17-1	566.79	4.956	
17-1	566.79	5.238	
17-1	566.79	5.233	
17-1	566.79	5.224	
17-1	566.79	5.222	
17-2	567.59	5.162	
17-2	567.59	5.489	
17-2	567.59	5.313	
17-2	567.59	5.269	
17-2	567.88	4.748	

TABLE 3 – *Continued*

Core Section	Sample Depth (m)	Velocity	Orientation
Site 330 *Continued*			
17-2	567.88	4.791	
17-2	567.88	4.793	
17-2	567.88	4.750	
17-2	567.88	4.416	
17-2	567.88	4.511	
17-2	567.88	4.484	
17-3	569.91	5.750	
17-3	569.91	5.679	
17-3	569.91	5.806	
17-3	569.91	5.709	
17-3	569.91	5.702	
17-3	569.91	5.680	
17-7	575.00	5.679	
17-7	575.00	5.613	
17-7	575.00	5.687	
17-7	575.00	5.684	
17-7	575.00	5.669	
17-7	575.00	5.648	
17-7	575.00	5.628	
Site 331			
1-1	2.05	1.538	
1-1	2.05	1.552	
1-2	3.50	1.536	
1-3	5.18	1.549	
1-3	5.18	1.549	
1-4	6.60	1.560	
1-5	8.06	1.545	
1-6	9.00	1.587	
1-6	9.00	1.550	
1-6	9.00	1.583	
1-6	9.00	1.548	

[a]Core orientation during velocity measurement was almost always horizontal (i.e., parallel to bedding). In this column, however, the appropriate symbol (H) is only shown when vertical measurements (V) were also made on the same sample, or when more than one horizontal measurement was made on the same sample.

Thicknesses of the liners available onboard varied by as much as 20%. By adopting an average liner thickness, the error introduced in measuring sonic velocities for the velocity range of soft sediments is less than 0.8%. In addition to the above-mentioned source of error, the effects of subjective alignment of the wave front used to measure travel times and the overall accuracy and precision of the Hamilton frame velocimeter on good samples is about 2% to 3%.

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