25. SOUND VELOCITY, ELASTIC CONSTANTS, AND RELATED PROPERTIES OF MARINE SEDIMENTS IN THE WESTERN EQUATORIAL PACIFIC: LEG 7, *GLOMAR CHALLENGER*

E. L. Gealy, Scripps Institution of Oceanography, La Jolla, California

ABSTRACT

The velocity of the compressional wave was measured with a shipboard velocimeter at three intervals along whole core sections 1.5 meters long for almost all sections of non-indurated and semi-indurated sediments recovered on Leg 7 of the D/V *Glomar Challenger* in the Western Equatorial Pacific. In addition, the compressional wave velocity was measured on selected samples of indurated materials with a velocimeter at the University of Hawaii. Disturbance by the coring process renders measurements on some core sections as unrepresentative of *in situ* conditions, but other measurements appear to approach the compressional wave velocity of *in situ* materials closely.

Measurements of compressional wave velocity, measurements of saturated bulk density and porosity reported in Chapter 25, and estimates of bulk modulus are used to compute impedance, rigidity, Lame's constant, Poisson's ratio, and the velocity of the shear wave for almost all core sections recovered on Leg 7.

Holes at Sites 62, 63 and 64 penetrated sequences of nannofossil ooze, chalk and limestone as deep as 960 meters beneath the sea floor, and range in age from Eocene to Recent.

The calcareous ooze-chalk sequences at these sites show an irregular exponential increase in compressional wave velocities with depth. The rates of increase at a given depth are greatest at Site 63 and least at Site 64. Compressional wave velocities at all three sites are about 1.45 to 1.50 km/sec at the surface. At 500 meters the compressional wave velocity is about 1.7 km/sec at Site 64, 2.1 km/sec at Site 62, and 2.3 km/sec at Site 63. A silicified limestone from 950 meters at Site 64 had a compressional wave velocity of 4.5 km/sec.

Shear wave velocities at these sites also increase with depth, but the rate of increase decreases with depth. Shear wave velocities at Site 64 are lower throughout than those at Sites 62 and 63.

Insufficient reliable data were collected on this leg to determine velocity gradients in either radiolarian ooze or pelagic clay.

The upper 20 to 30 meters of the calcareous ooze at Sites 62, 63 and 64 has a compressional wave velocity less than in seawater. Near surface sediments at Sites 65 and 66 also have compressional wave velocities less than that in seawater. Thus, a low velocity channel exists in these upper sediments.

The velocity at the compressional wave decreases as the fraction clay size increases where other parameters are the

same. Cementation at Sites 62, 63 and 64 tends to obliterate this relationship.

Measurements of compressional wave velocity parallel and perpendicular to bedding indicate that some anisotropy may exist in calcareous sediments. Samples having a horizontal velocity less than 2.0 km/sec had a higher vertical velocity than horizontal; samples having a horizontal velocity more than 2.0 km/sec had a lower vertical velocity than horizontal. In unconsolidated and semiconsolidated calcareous deposits, advective fluid may cause a vertical grain to develop; compaction may destroy this grain in indurated sediments, crushing grain horizontal layers.

INTRODUCTION

Compressional wave velocities were measured on sediment cores and samples recovered on Leg 7; and, these data, together with saturated bulk density measurements, permit derivation of several other elastic constants for marine sediment sections in the Western Equatorial Pacific.

METHODS

Because the acoustic properties of rocks depend on vectoral properties which are changed by removing a sample from its *in situ* environment to the laboratory, it is important to obtain sound velocity measurements *in situ* if possible. Down-hole acoustic logging devices exist which can measure the velocity of the compressional wave *in situ*, but no such tools were available on Leg 7.

The only means of determining the velocity of the compressional wave on Leg 7 were: 1) by comparing travel time to prominent reflectors on seismic profiling records with driller's depths to a change in lithology that might cause a change in acoustic impedance, and 2) by measuring the velocity of the compressional wave in core sections in the laboratory. Seismic profiling records are discussed elsewhere in this volume. Measurements of the velocity of the compressional wave were made on almost all core sections retrieved on Leg 7 of the D/V *Glomar Challenger* by techniques described below. These measurements, together with measurements of some related properties, provide the basis of this study. Values of saturated bulk density and porosity used in this chapter are from studies reported in Gealy (1971).

Instrumentation and Laboratory Techniques

Aboard the D/V *Glomar Challenger* on Leg 7, some velocity measurements were made on unsplit core sections using an Underwater Systems Laboratory Sonic Velocimeter. Velocity measurements were commonly made at three places along each 150-centimeter section if the condition of the core indicated that measurements might be valid. In general, velocity measurements were omitted on sections either partially empty or containing much water.

The device consists of a pulse generator emitting a 250 volt pulse of about 0.5 microseconds which excites a barium titanate transducer to emit compressional pulses at a natural resonant frequency of about 400 kHz. The transmitted pulse triggers an oscilloscope which displays the incoming signals.

The velocity of the compressional wave in the sediment is determined from the difference between the measured transmission time across the diameter of the whole core section through the liner, and across a reference sample of liner filled with distilled water. Details of the equipment and procedures are outlined in DSDP Volume II in the Initial Core Descriptions, (Peterson *et. al.*, 1969).

The temperature of each core section was measured at the time that velocity was measured, and values ranged from 22°C to 27.4°C. All values of velocity were corrected to 23°C by

$$\frac{V_p}{V_p'} = \frac{V_w}{V_w'},$$

where V_p = velocity of compressional wave corrected to 23°C,

V_p' = velocity of compressional wave at laboratory temperature (measured),

V_w = velocity of seawater at 35 °/oo salinity at 23°C,

V_w' = velocity of seawater at 35 °/oo salinity at laboratory temperature (measured).

The velocimeter described above is designed to measure the velocity of the compressional wave only in unconsolidated and semiconsolidated sediments in plastic core liners.

Also aboard the D/V *Glomar Challenger* on Leg 7 was a microtrans device designed to measure the velocity of the compressional wave in indurated rock samples. Details of the instrumentation and procedures are given in Volume II of the *Initial Reports of the Deep Sea Drilling Project.* On Leg 7 this device consistently failed to yield meaningful results.

In order to supplement shipboard measurements, the velocity of the compressional wave was determined in selected oriented samples of indurated materials from all sites, except Site 61, by a velocimeter at the Core Analysis Laboratory of the Hawaii Institute of Geophysics, University of Hawaii.

Sources of Error

Measurements of the velocity of the compressional wave by these laboratory techniques may differ from *in situ* velocities substantially.

First, simply by removing the sediment to the laboratory and thus from its *in-situ* temperature, pore pressure and confining pressure, changes the velocity (V_p).

Second, the drilling and coring process disturbs the cored materials (Chapter 2, this volume) and, in some cases, completely destroys any rigidity the rock may have had. The coring process may cause either an increase or a decrease in porosity, although on this leg an increase in porosity is more common. Thus, such disturbances commonly result in a reduction in velocity (V_p).

On Sites 62, 63 and 64, when soft nannofossil chalk was cored, the drilling rhythm caused the recovery of a series of "biscuits" of undisturbed chalk separated by variable thicknesses of pulverized chalk paste. Commonly the chalk biscuits would be fractured, and cores received in this condition were of doubtful value for sonic velocity measurements using the shipboard velocimeter. The fractured part of the original chalk would not transmit the sonic pulse at all, and no reading could be taken there. The paste would transmit the pulse between the transducer head pads, but, of course, it was not representative of the actual rock. While processing Core 8 of Hole 63.0, Heath and Moberley attempted to make sonic measurements along the entire length of Section 2, rather than only at the three standard places. The unopened core liner was marked where no signal was transmitted across the core. Subsequently, when the section was split it could be seen that each of the nine segments marked as worthless for velocity measurements were segments of chalk, whereas all the measurements that were taken were across mud. The observations were confirmed on several additional cores.

Third, the geometry of the cores and the measuring equipment may result in errors. The outside diameter of the core liners varies from section to section, and the velocity measurements are diameter dependent. The thickness of the liner wall varies from section to section and is not measured. All cores retrieved contain a slurry of diluted, homogenized sediment paste between the liner and the core proper. The thickness of this slurry is variable, but is commonly 1 to 5 millimeters thick.

Because most of these factors tend to result in measurements less than the *in situ* velocity, except where otherwise noted, it has been assumed that the maximum of the three compressional velocity measurements made on any section most closely approximates the true *in situ* velocity. It is these maximum measurements [$V_{p(max.)}$] which are listed in the tables in Chapters 2 through 4 and are plotted as a function of depth on the core sheets and site summaries in those chapters, and on Figures 1 through 6 in this chapter. In this chapter, these maximum values are listed in Tables 1 through 6, and are shown plotted as a function of depth on Figures 1 through 6.

DEFINITIONS AND RELATIONSHIPS

The following definitions and relationships are used in this study; the values of all properties are for the laboratory (1 atmosphere pressure), and 23°C:

Saturated Bulk Density and Porosity

$$\rho_B = \phi\rho_F + (1-\phi)\rho_G \qquad (1)$$

where: ϕ = porosity: that fraction of total volume of sediment in its fully saturated state, not occupied by solid components,

ρ = density in grams per cubic centimeter of the interstitial fluid in a sediment core in its fully saturated state at its natural salinity,

ρ_G = weighted mean bulk density in grams per cubic centimeter of the solid component of a sediment core, excluding solids dissolved in the interstitial water.

Values of Saturated Bulk Density and Porosity (Gealy, 1971) are listed in Tables 1 through 6 and are shown plotted as a function of depth on Figures 1 through 6.

Velocity Compressional Wave

For purposes of this study, it is assumed that a compressional wave moving in saturated sediments is of such small amplitude and short duration that its passage results in no loss of fluids and no permanent

TABLES 1 through 6
Sound Velocity, Elastic Constants and Related Properties

Identification															
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
							Table 1. Site 61								
61.1	1	2	Porcelanite, mudstone shale and siltstone	85.25	1.98	40.8	1.726	3419	37.700	1.621	6.581	0.000	6.581	0.500	0.000
							Table 2. Site 62								
62.0	1	1	Nannofossil chalk ooze	91.75	1.66	60.4	1.590	2646	67.584	0.259	4.108	0.094	4.045	0.489	0.238
62.0	1	2	Nannofossil chalk ooze	93.25	1.67	61.8	1.679	2801	66.703	0.227	3.996	1.097	3.264	0.374	0.811
62.0	1	3	Nannofossil chalk ooze	94.75	1.68	60.8	1.616	2721	68.535	0.249	4.076	0.242	3.915	0.471	0.379
62.0	1	4	Nannofossil chalk ooze	96.25	1.66	62.3	1.601	2658	67.584	0.217	3.961	0.236	3.804	0.471	0.377
62.0	1	5	Nannofossil chalk ooze	97.75	1.66	62.4	1.595	2643	65.645	0.214	3.947	0.273	3.764	0.466	0.406
62.0	1	6	Nannofossil chalk ooze	99.25	1.65	62.9	1.602	2641	67.865	0.205	3.916	0.249	3.750	0.469	0.389
62.0	2	2	Nannofossil chalk ooze	207.25	1.73	58.4	1.729	2982	69.275	0.311	4.280	0.884	3.691	0.403	0.716
62.0	2	3	Nannofossil chalk ooze	208.75	1.73	58.4	1.678	2896	68.359	0.314	4.285	0.470	3.972	0.447	0.522
62.0	2	4	Nannofossil chalk ooze	210.25	1.72	58.5	1.722	2958	69.240	0.310	4.277	0.676	3.826	0.425	0.626
62.0	2	5	Nannofossil chalk ooze	211.75	1.73	58.1	1.675	2900	69.733	0.322	4.315	0.441	4.021	0.451	0.505
62.0	2	6	Nannofossil chalk ooze	213.25	1.73	58.2	1.704	2945	70.755	0.317	4.301	0.538	3.942	0.440	0.558
62.0	3	1	Nannofossil chalk ooze	299.75	1.75	57.2	1.829	3194	69.768	0.350	4.396	1.189	3.603	0.376	0.825
62.0	3	2	Nannofossil chalk ooze	301.25	1.72	58.6	1.752	3017	71.883	0.307	4.272	1.032	3.584	0.388	0.774
62.0	3	3	Nannofossil chalk ooze	302.75	1.73	57.9	1.829	3169	68.923	0.326	4.324	1.201	3.523	0.373	0.832
62.0	3	4	Nannofossil chalk ooze	304.25	1.74	57.6	1.808	3143	69.698	0.337	4.358	1.147	3.594	0.379	0.812
62.0	3	5	Nannofossil chalk ooze	305.75	1.77	55.8	1.854	3279	70.826	0.398	4.535	1.278	3.683	0.371	0.850
62.0	3	6	Nannofossil chalk ooze	307.25	1.73	58.1	1.848	3197	68.817	0.321	4.308	1.478	3.323	0.346	0.924
62.0	4	1	Nannofossil chalk ooze and chalk	395.75	1.75	56.7	1.968	3452	65.293	0.366	4.434	1.916	3.157	0.311	1.045
62.0	4	2	Nannofossil chalk ooze and chalk	397.25	1.88	49.6	1.904	3571	67.901	0.714	5.289	1.169	4.509	0.397	0.790
62.0	4	3	Nannofossil chalk ooze and chalk	398.75	1.87	50.1	2.040	3805	66.879	0.678	5.207	2.258	3.702	0.311	1.100

62.0	4	4	Nannofossil chalk ooze and chalk	400.25	1.70	59.9	1.911	3249	66.244	0.272	4.149	1.682	3.027	0.321	0.995
62.0	4	5	Nannofossil chalk ooze and chalk	401.75	1.83	52.2	1.926	3524	67.125	0.558	4.935	1.459	3.962	0.365	0.893
62.0	4	6	Nannofossil chalk ooze and chalk	403.25	1.74	57.6	1.939	3369	65.786	0.336	4.347	1.949	3.048	0.305	1.059
62.0	5	2	Nannofossil chalk ooze and chalk	492.25	1.86	50.3	1.999	3723	69.099	0.666	5.189	1.818	3.976	0.343	0.988
62.0	5	3	Nannofossil chalk ooze and chalk	493.75	1.90	48.2	2.020	3834	68.923	0.811	5.499	2.070	4.119	0.333	1.044
62.0	5	4	Nannofossil chalk ooze and chalk	495.25	1.95	44.9	2.165	4227	70.368	1.099	6.066	3.168	3.955	0.278	1.274
62.1	1	2	Foraminiferal nanno-fossil chalk ooze	8.25	1.42	76.8	1.545	2185	59.584	0.056	3.134	0.252	2.965	0.461	0.422
62.1	1	3	Foraminiferal nanno-fossil chalk ooze	9.75	1.51	71.1	1.510	2282	57.611	0.096	3.401	0.113	3.325	0.484	0.273
62.1	2	2	Foraminiferal nanno-fossil chalk ooze	17.25	1.50	71.8	1.504	2256							
62.1	2	3	Foraminiferal nanno-fossil chalk ooze	18.75	1.53	69.7	1.502	2305							
62.1	2	4	Foraminiferal nanno-fossil chalk ooze	20.25	1.53	70.0	1.480	2264							
62.1	4	1	Nannofossil chalk ooze	34.75	1.50	71.9	1.679	2517	63.143	0.089	3.367	0.686	2.910	0.405	0.676
62.1	4	2	Nannofossil chalk ooze	36.25	1.52	70.6	1.542	2342	62.720	0.100	3.429	0.162	3.322	0.477	0.326
62.1	4	3	Nannofossil chalk ooze	37.75	1.51	71.1	1.529	2311							
62.1	4	4	Nannofossil chalk ooze	39.25	1.55	68.8	1.532	2373	65.822	0.118	3.531	0.121	3.451	0.483	0.279
62.1	4	5	Nannofossil chalk ooze	40.75	1.58	67.3	1.693	2668	65.927	0.136	3.623	0.747	3.125	0.404	0.688
62.1	4	6	Nannofossil chalk ooze	42.25	1.57	67.6	1.644	2582	64.412	0.132	3.601	0.643	3.172	0.416	0.640
62.1	6	1	Nannofossil marl ooze	54.75	1.50	71.5	1.543	2328	55.355	0.092	3.376	0.171	3.261	0.475	0.338
62.1	6	2	Nannofossil chalk ooze	56.25	1.51	71.2	1.529	2308	66.244	0.094	3.403	0.149	3.303	0.478	0.315
62.1	6	3	Nannofossil chalk ooze	57.75	1.52	70.9	1.548	2346	63.637	0.098	3.419	0.208	3.279	0.470	0.371

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm$^2 \times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm$^2 \times 10^{10}$; K = bulk modulus sediment, dynes/cm$^2 \times 10^{10}$; μ = rigidity, dynes/cm$^2 \times 10^{10}$; λ = Lame's constant, dynes/cm$^2 \times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification																
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
62.1	6	4	Nannofossil marl ooze	59.25	1.53	69.9	1.550	2373	58.527	0.106	3.462	0.194	3.332	0.472	0.356
62.1	6	5	Nannofossil chalk ooze	60.75	1.54	69.6	1.570	2412	63.883	0.109	3.486	0.331	3.265	0.454	0.464
62.1	6	6	Nannofossil chalk ooze	62.25	1.59	66.5	1.552	2465	64.482	0.146	3.667	0.155	3.564	0.479	0.313
62.1	7	1	Nannofossil chalk ooze	63.75	1.55	68.8	1.555	2409	61.487	0.118	3.527	0.182	3.406	0.475	0.343
62.1	7	2	Nannofossil chalk ooze	65.25	1.60	65.7	1.569	2515	60.606	0.159	3.718	0.175	3.601	0.477	0.331
62.1	7	3	Nannofossil chalk ooze	66.75	1.57	67.9	1.543	2415	63.883	0.129	3.583	0.114	3.507	0.484	0.270
62.1	7	4	Nannofossil chalk ooze	68.25	1.55	69.1	1.552	2397	59.478	0.115	3.511	0.197	3.380	0.472	0.357
62.1	7	5	Nannofossil chalk ooze	69.75	1.63	64.4	1.548	2515	68.817	0.179	3.814	0.087	3.756	0.489	0.231
62.1	7	6	Nannofossil chalk ooze	71.25	1.57	67.5	1.535	2411	64.835	0.133	3.606	0.108	3.535	0.485	0.262
62.1	8	2	Nannofossil chalk ooze	74.25	1.62	64.5	1.537	2495	60.536	0.177	3.795	0.071	3.748	0.491	0.209
62.1	8	3	Nannofossil chalk ooze	75.75	1.61	65.5	1.568	2516	61.698	0.161	3.728	0.198	3.596	0.474	0.351
62.1	8	4	Nannofossil chalk ooze	77.25	1.63	64.2	1.543	2512	66.315	0.182	3.824	0.047	3.792	0.494	0.170
62.1	8	5	Nannofossil chalk ooze	78.75	1.61	65.1	1.567	2526	63.637	0.167	3.756	0.178	3.637	0.477	0.333
62.1	8	6	Nannofossil chalk ooze	80.25	1.63	64.4	1.546	2512	63.390	0.179	3.806	0.070	3.759	0.491	0.208
62.1	9	2	Nannofossil chalk ooze	83.25	1.60	65.9	1.546	2474	65.575	0.156	3.711	0.104	3.642	0.486	0.254
62.1	9	2	Nannofossil chalk ooze	84.75	1.64	63.6	1.527	2501	63.778	0.193	3.863	0.043	3.834	0.495	0.162
62.1	9	4	Nannofossil chalk ooze	86.25	1.59	66.3	1.565	2491	59.725	0.149	3.674	0.173	3.559	0.477	0.329
62.1	10	1	Nannofossil marl ooze	92.75	1.58	67.3	1.510	2380	54.545	0.136	3.608	0.014	3.599	0.498	0.094
62.1	10	2	Nannofossil chalk ooze	94.25	1.55	68.8	1.541	2388	64.482	0.118	3.532	0.170	3.418	0.476	0.331
62.1	10	3	Nannofossil chalk ooze	95.75	1.58	67.3	1.543	2430	60.782	0.136	3.615	0.163	3.507	0.478	0.322
62.1	10	4	Nannofossil chalk ooze	97.25	1.57	67.4	1.528	2404	64.800	0.135	3.613	0.088	3.554	0.488	0.237
62.1	10	5	Nannofossil chalk ooze	98.75	1.59	66.5	1.573	2499	63.249	0.147	3.667	0.289	3.475	0.462	0.427
62.1	10	6	Nannofossil chalk ooze	100.25	1.63	63.8	1.556	2542	64.835	0.188	3.846	0.136	3.755	0.483	0.289
62.1	11	1	Nannofossil chalk ooze	101.75	1.65	62.9	1.603	2643	65.363	0.205	3.912	0.280	3.725	0.465	0.412
62.1	11	2	Nannofossil chalk ooze	103.25	1.61	65.3	1.602	2577	65.363	0.164	3.749	0.340	3.522	0.456	0.460
62.1	11	3	Nannofossil chalk ooze	104.75	1.63	64.0	1.563	2547	65.610	0.184	3.832	0.166	3.721	0.479	0.319
62.1	11	4	Nannofossil chalk ooze	106.25	1.63	63.9	1.592	2599	61.980	0.187	3.838	0.245	3.674	0.469	0.388
62.1	11	5	Nannofossil chalk ooze	107.75	1.62	64.4	1.614	2621	64.800	0.178	3.806	0.374	3.557	0.453	0.480

62.1	11	6	Nannofossil chalk ooze	109.25	1.62	64.8	1.576	2549	65.046	0.171	3.778	0.287	3.587	0.463	0.421
62.1	12	1	Nannofossil chalk ooze	110.75	1.62	64.5	1.553	2520	65.504	0.177	3.801	0.123	3.719	0.484	0.275
62.1	12	2	Nannofossil chalk ooze	112.25	1.64	63.8	1.572	2569	67.161	0.189	3.854	0.159	3.748	0.480	0.312
62.1	12	3	Nannofossil chalk ooze	113.75	1.67	61.6	1.622	2711	67.302	0.232	4.014	0.416	3.736	0.450	0.499
62.1	12	4	Nannofossil chalk ooze	115.25	1.69	60.4	1.578	2669	67.125	0.260	4.112	0.120	4.032	0.486	0.266
62.1	12	5	Nannofossil chalk ooze	116.75	1.65	62.9	1.587	2616	66.738	0.205	3.914	0.263	3.739	0.467	0.399
62.1	12	6	Nannofossil chalk ooze	118.25	1.68	60.9	1.611	2709	68.077	0.246	4.066	0.245	3.903	0.471	0.382
62.1	13	5	Nannofossil chalk ooze	125.75	1.62	64.6	1.637	2654	67.302	0.175	3.798	0.498	3.466	0.437	0.554
62.1	14	2	Nannofossil chalk ooze	131.25	1.55	68.6	1.586	2465	67.478	0.121	3.549	0.311	3.341	0.457	0.447
62.1	14	3	Nannofossil chalk ooze	132.75	1.63	64.3	1.599	2602	68.218	0.181	3.821	0.353	3.586	0.455	0.466
62.1	14	4	Nannofossil chalk ooze	134.25	1.64	63.7	1.681	2750	65.117	0.190	3.854	0.601	3.453	0.426	0.606
62.1	14	5	Nannofossil chalk ooze	135.75	1.59	66.4	1.618	2572	67.865	0.147	3.677	0.403	3.408	0.447	0.503
62.1	14	6	Nannofossil chalk ooze	137.25	1.49	72.2	1.601	2390	67.407	0.086	3.354	0.437	3.063	0.438	0.541
62.1	15	2	Nannofossil chalk ooze	140.25	1.66	62.3	1.650	2739	67.865	0.217	3.961	0.464	3.652	0.444	0.529
62.1	15	3	Nannofossil chalk ooze	141.75	1.66	62.2	1.612	2677	68.218	0.219	3.967	0.262	3.793	0.468	0.397
62.1	15	4	Nannofossil chalk ooze	143.25	1.66	62.1	1.648	2742	58.879	0.222	3.963	0.417	3.685	0.449	0.501
62.1	15	5	Nannofossil chalk ooze	144.75	1.67	61.9	1.660	2765	61.522	0.225	3.978	0.477	3.660	0.443	0.535
62.1	15	6	Nannofossil chalk ooze	146.25	1.68	61.3	1.619	2716	66.914	0.239	4.039	0.432	3.751	0.448	0.508
62.1	16	2	Nannofossil chalk ooze	149.25	1.65	62.7	1.638	2708	68.887	0.209	3.933	0.500	3.599	0.439	0.550
62.1	16	3	Nannofossil chalk ooze	150.75	1.69	60.6	1.635	2760	68.288	0.255	4.095	0.434	3.805	0.449	0.507
62.1	16	4	Nannofossil chalk ooze	152.25	1.70	59.8	1.620	2756	67.161	0.273	4.155	0.273	3.973	0.468	0.401
62.1	16	5	Nannofossil chalk ooze	153.75	1.69	60.4	1.650	2791	69.134	0.259	4.111	0.397	3.847	0.453	0.484
62.1	16	6	Nannofossil chalk ooze	155.25	1.73	58.4	1.649	2845	66.139	0.312	4.276	0.384	4.019	0.456	0.472
62.1	17	2	Nannofossil chalk ooze	158.25	1.69	60.4	1.594	2698	68.147	0.260	4.111	0.214	3.968	0.474	0.356
62.1	17	3	Nannofossil chalk ooze	159.75	1.69	60.4	1.595	2697	71.989	0.258	4.112	0.183	3.990	0.478	0.329
62.1	17	4	Nannofossil chalk ooze	161.25	1.71	59.6	1.664	2837	69.310	0.279	4.178	0.571	3.797	0.435	0.579
62.1	17	5	Nannofossil chalk ooze	162.75	1.71	59.2	1.626	2785	70.473	0.291	4.219	0.253	4.050	0.471	0.385

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
62.1	17	6	Nannofossil chalk ooze	164.25	1.72	58.6	1.575	2711	67.020	0.306	4.257	0.037	4.233	0.496	0.147
62.1	18	1	Nannofossil chalk ooze	165.75	1.77	55.6	1.669	2959	68.711	0.406	4.553	0.510	4.213	0.446	0.536
62.1	18	2	Nannofossil chalk ooze	167.25	1.77	56.0	1.706	3012	69.804	0.392	4.517	0.558	4.145	0.441	0.562
62.1	18	3	Nannofossil chalk ooze	168.75	1.72	58.9	1.669	2865	70.826	0.297	4.239	0.466	3.928	0.447	0.521
62.1	18	4	Nannofossil chalk ooze	170.25	1.76	56.6	1.683	2956	70.649	0.370	4.457	0.495	4.127	0.446	0.531
62.1	18	5	Nannofossil chalk ooze	171.75	1.74	57.8	1.711	2969	68.676	0.330	4.335	0.644	3.905	0.429	0.609
62.1	18	6	Nannofossil chalk ooze	173.25	1.77	55.9	1.646	2908	68.993	0.394	4.521	0.399	4.255	0.457	0.475
62.1	19	2	Nannofossil chalk ooze	176.25	1.68	61.1	1.700	2857	71.037	0.243	4.060	0.726	3.576	0.416	0.657
62.1	19	3	Nannofossil chalk ooze	177.75	1.77	55.5	1.716	3044	71.530	0.410	4.569	0.532	4.214	0.444	0.548
62.1	19	4	Nannofossil chalk ooze	179.25	1.76	56.3	1.682	2962	70.262	0.381	4.488	0.518	4.143	0.444	0.543
62.1	19	5	Nannofossil chalk ooze	180.75	1.71	59.6	1.650	2814	70.121	0.280	4.182	0.462	3.874	0.447	0.520
62.1	19	6	Nannofossil chalk ooze	182.25	1.77	56.0	1.625	2868	59.549	0.389	4.483	0.163	4.374	0.482	0.304
62.1	20	1	Nannofossil chalk ooze	186.75	1.72	59.0	1.661	2849	69.698	0.295	4.231	0.500	3.897	0.443	0.540
62.1	20	2	Nannofossil chalk ooze	188.25	1.74	57.8	1.658	2878	65.540	0.332	4.335	0.376	4.084	0.458	0.465
62.1	20	3	Nannofossil chalk ooze	189.75	1.74	57.4	1.638	2853	70.508	0.343	4.378	0.231	4.224	0.474	0.364
62.1	20	4	Nannofossil chalk ooze	191.25	1.77	56.1	1.663	2935	69.205	0.389	4.506	0.334	4.284	0.464	0.435
62.1	20	5	Nannofossil chalk ooze	192.75	1.74	57.3	1.646	2870	70.473	0.346	4.387	0.353	4.152	0.461	0.450
62.1	20	6	Nannofossil chalk ooze	194.25	1.75	56.9	1.536	2688	70.438	0.359	4.424	0.000	4.424	0.500	0.000
62.1	21	1	Nannofossil chalk ooze and chalk	195.75	1.72	58.7	1.572	2705	68.993	0.305	4.259	0.061	4.218	0.493	0.188
62.1	21	2	Nannofossil chalk ooze and chalk	197.25	1.78	55.3	1.682	3010	70.931	0.417	4.589	0.358	4.350	0.462	0.449
62.1	21	3	Nannofossil chalk ooze and chalk	198.75	1.78	55.0	1.595	2843	69.205	0.429	4.616	0.021	4.602	0.498	0.109
62.1	21	4	Nannofossil chalk ooze and chalk	200.25	1.80	54.1	1.594	2865	67.055	0.467	4.710	0.000	4.710	0.500	0.000

62.1	21	5	Nannofossil chalk ooze and chalk	201.75	1.80	54.0	1.692	3027	70.614	0.473	4.734	0.384	4.478	0.461	0.462
62.1	21	6	Nannofossil chalk ooze and chalk	203.25	1.80	53.7	1.580	2850	63.954	0.483	4.743	0.000	4.743	0.500	0.000
62.1	22	1	Nannofossil chalk ooze and chalk	207.75	1.76	56.3	1.523	2682	70.191	0.380	4.485	0.000	4.485	0.500	0.000
62.1	22	2	Nannofossil chalk ooze and chalk	209.25	1.77	56.0	1.632	2882	70.332	0.391	4.515	0.159	4.409	0.483	0.300
62.1	22	3	Nannofossil chalk ooze and chalk	210.75	1.81	53.5	1.633	2953	69.346	0.494	4.785	0.522	4.437	0.447	0.537
62.1	22	4	Nannofossil chalk ooze and chalk	212.25	1.78	55.2	1.585	2822	69.592	0.422	4.600	0.084	4.544	0.491	0.217
62.1	22	5	Nannofossil chalk ooze and chalk	213.75	1.82	52.7	1.688	3076	70.156	0.533	4.883	0.283	4.694	0.472	0.394
62.1	22	6	Nannofossil chalk ooze and chalk	215.25	1.74	57.4	1.539	2680	69.909	0.343	4.377	0.000	4.377	0.500	0.000
62.1	23	1	Nannofossil chalk ooze and chalk	216.75	1.77	55.8	1.541	2727	68.676	0.398	4.530	0.000	4.530	0.500	0.000
62.1	23	2	Nannofossil chalk ooze and chalk	218.25	1.79	54.5	1.646	2949	64.201	0.451	4.662	0.257	4.491	0.473	0.378
62.1	23	3	Nannofossil chalk ooze and chalk	219.75	1.79	54.2	1.537	2759	58.950	0.460	4.669	0.000	4.669	0.500	0.000
62.1	23	4	Nannofossil chalk ooze and chalk	221.25	1.80	53.9	1.546	2784	69.134	0.475	4.736	0.000	4.736	0.500	0.000
62.1	23	5	Nannofossil chalk ooze and chalk	222.75	1.79	54.6	1.693	3030	62.227	0.447	4.646	0.474	4.330	0.451	0.514
62.1	24	1	Nannofossil chalk and chalk ooze	225.75	1.82	53.0	1.592	2893	72.059	0.519	4.854	0.000	4.854	0.500	0.000
62.1	24	2	Nannofossil chalk and chalk ooze	227.25	1.75	56.7	1.748	3067	70.826	0.365	4.443	0.747	3.945	0.420	0.653

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm$^2 \times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm$^2 \times 10^{10}$; K = bulk modulus sediment, dynes/cm$^2 \times 10^{10}$; μ = rigidity, dynes/cm$^2 \times 10^{10}$; λ = Lame's constant, dynes/cm$^2 \times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification																
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
62.1	24	3	Nannofossil chalk and chalk ooze	228.75	1.78	54.9	1.595	2846	69.416	0.433	4.628	0.000	4.628	0.500	0.000
62.1	24	4	Nannofossil chalk and chalk ooze	230.25	1.78	54.9	1.636	2918	69.592	0.431	4.623	0.136	4.533	0.486	0.276
62.1	24	5	Nannofossil chalk and chalk ooze	231.75	1.77	55.7	1.716	3039	62.051	0.403	4.528	0.561	4.153	0.441	0.563
62.1	24	6	Nannofossil chalk and chalk ooze	233.25	1.79	54.8	1.576	2815	68.006	0.436	4.632	0.000	4.632	0.500	0.000
62.1	25	1	Nannofossil chalk and chalk ooze	234.75	1.74	57.5	1.584	2757	69.592	0.339	4.364	0.105	4.294	0.488	0.246
62.1	25	2	Nannofossil chalk and chalk ooze	236.25	1.44	75.2	1.687	2434	68.394	0.065	3.212	0.734	2.723	0.394	0.713
62.1	25	3	Nannofossil chalk and chalk ooze	237.75	1.71	59.4	1.582	2704	68.958	0.285	4.195	0.139	4.103	0.484	0.285
62.1	25	4	Nannofossil chalk and chalk ooze	239.25	1.74	57.4	1.586	2765	67.760	0.344	4.375	0.099	4.309	0.489	0.238
62.1	25	5	Nannofossil chalk and chalk ooze	240.75	1.41	77.3	1.655	2327	68.465	0.053	3.117	0.632	2.695	0.405	0.670
62.1	25	6	Nannofossil chalk and chalk ooze	242.25	1.73	58.0	1.574	2727							
62.1	26	1	Nannofossil chalk and chalk ooze	245.75	1.75	56.9	1.656	2897	64.623	0.358	4.408	0.425	4.125	0.453	0.493
62.1	26	2	Nannofossil chalk and chalk ooze	247.25	1.72	58.9	1.644	2821							
62.1	26	3	Nannofossil chalk and chalk ooze	248.75	1.75	56.7	1.544	2709	67.584	0.366	4.439	0.000	4.439	0.500	0.000
62.1	26	4	Nannofossil chalk and chalk ooze	250.25	1.77	56.1	1.601	2826	67.407	0.388	4.502	0.149	4.402	0.484	0.291

62.1	26	5	Nannofossil chalk and chalk ooze	251.75	1.73	58.2	1.648	2849	70.508	0.319	4.305	0.336	4.081	0.462	0.441
62.1	26	6	Nannofossil chalk and chalk ooze	253.25	1.69	60.5	1.549	2620	67.760	0.258	4.104	0.076	4.054	0.491	0.212
62.1	27	2	Nannofossil chalk and chalk ooze	256.25	1.72	58.8	1.664	2859	68.006	0.301	4.244	0.385	3.987	0.456	0.473
62.1	27	3	Nannofossil chalk and chalk ooze	257.75	1.74	57.7	1.587	2755	63.883	0.332	4.332	0.101	4.264	0.488	0.241
62.1	27	4	Nannofossil chalk and chalk ooze	259.25	1.78	55.4	1.715	3045	68.711	0.414	4.576	0.541	4.215	0.443	0.552
62.1	27	5	Nannofossil chalk and chalk ooze	260.75	1.77	55.6	1.621	2874	69.275	0.406	4.554	0.130	4.467	0.486	0.271
62.1	28	1	Nannofossil chalk and chalk ooze	263.75	1.69	60.8	1.595	2687	67.971	0.250	4.077	0.247	3.912	0.470	0.383
62.1	28	2	Nannofossil chalk and chalk ooze	265.25	1.72	58.9	1.683	2890	68.288	0.298	4.237	0.566	3.860	0.436	0.574
62.1	28	3	Nannofossil chalk and chalk ooze	266.75	1.75	56.7	1.610	2822	66.491	0.365	4.433	0.096	4.369	0.489	0.234
62.1	28	4	Nannofossil chalk and chalk ooze	268.25	1.70	59.9	1.602	2725	63.883	0.273	4.147	0.184	4.024	0.478	0.329
62.1	28	5	Nannofossil chalk and chalk ooze	269.75	1.67	61.6	1.693	2829	66.033	0.231	4.008	0.628	3.589	0.426	0.613
62.1	28	6	Nannofossil chalk and chalk ooze	271.25	1.69	60.8	1.609	2711	55.990	0.249	4.052	0.278	3.867	0.467	0.406
62.1	29	1	Nannofossil chalk and chalk ooze	271.75	1.69	60.3	1.640	2778	70.121	0.262	4.123	0.472	3.808	0.445	0.528
62.1	29	2	Nannofossil chalk and chalk ooze	273.25	1.69	60.5	1.761	2974	68.147	0.256	4.098	1.257	3.260	0.361	0.863
62.1	29	3	Nannofossil chalk and chalk ooze	274.75	1.71	59.3	1.673	2860	67.478	0.287	4.201	0.512	3.860	0.442	0.547

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification																
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
62.1	29	4	Nannofossil chalk and chalk ooze	276.25	1.68	60.9	1.645	2771	67.443	0.248	4.071	0.512	3.730	0.440	0.551
62.1	29	5	Nannofossil chalk and chalk ooze	277.75	1.71	59.5	1.696	2894	68.147	0.281	4.182	0.632	3.761	0.428	0.608
62.1	29	6	Nannofossil chalk and chalk ooze	279.25	1.70	59.9	1.655	2813	67.689	0.272	4.151	0.438	3.859	0.449	0.508
62.1	30	1	Nannofossil chalk and chalk ooze	281.75	1.74	57.8	1.640	2845	68.535	0.329	4.333	0.306	4.130	0.466	0.420
62.1	30	2	Nannofossil chalk and chalk ooze	283.25	1.72	58.6	1.744	3003	68.535	0.307	4.264	0.817	3.719	0.410	0.689
62.1	30	3	Nannofossil chalk and chalk ooze	284.75	1.75	56.7	1.653	2899	68.570	0.365	4.439	0.388	4.180	0.458	0.470
62.1	30	4	Nannofossil chalk and chalk ooze	286.25	1.74	57.4	1.636	2850	69.698	0.343	4.378	0.304	4.175	0.466	0.418
62.1	30	5	Nannofossil chalk and chalk ooze	287.75	1.74	57.6	1.748	3039	69.099	0.337	4.358	1.000	3.692	0.394	0.758
62.1	30	6	Nannofossil marl and marl ooze	289.25	1.71	59.2	1.620	2773	52.043	0.290	4.173	0.278	3.988	0.468	0.403
62.1	31	1	Nannofossil chalk and chalk ooze	291.75	1.77	55.8	1.621	2868	68.570	0.397	4.528	0.195	4.398	0.479	0.332
62.1	31	2	Nannofossil chalk and chalk ooze	293.25	1.75	56.7	1.792	3143	67.936	0.365	4.438	1.233	3.616	0.373	0.838
62.1	31	3	Nannofossil chalk and chalk ooze	294.75	1.78	55.1	1.643	2926	68.359	0.425	4.604	0.237	4.446	0.475	0.365
62.1	31	4	Nannofossil chalk and chalk ooze	296.25	1.79	54.6	1.614	2889	68.006	0.447	4.662	0.110	4.588	0.488	0.248
62.1	31	5	Nannofossil chalk and chalk ooze	297.75	1.70	59.9	1.727	2937	68.746	0.272	4.155	0.773	3.640	0.412	0.674

62.1	31	6	Nannofossil chalk and chalk ooze	299.25	1.78	55.2	1.610	2865	69.240	0.424	4.602	0.065	4.559	0.493	0.191
62.1	32	1	Nannofossil chalk	301.75	1.73	58.4	1.705	2941	69.169	0.312	4.282	0.809	3.743	0.411	0.685
62.1	32	2	Nannofossil chalk	303.25	1.75	56.8	1.775	3110	69.627	0.363	4.434	0.937	3.809	0.401	0.731
62.1	32	3	Nannofossil chalk	304.75	1.74	57.6	1.705	2963	70.473	0.336	4.357	0.720	3.877	0.422	0.644
62.1	32	4	Nannofossil chalk	306.25	1.73	58.1	1.761	3048	63.883	0.323	4.304	1.201	3.503	0.372	0.833
62.1	32	5	Nannofossil chalk	307.75	1.73	58.2	1.816	3144	69.169	0.322	4.311	1.109	3.572	0.382	0.801
62.1	32	6	Nannofossil chalk	309.25	1.73	58.1	1.788	3093	68.218	0.321	4.309	1.147	3.544	0.378	0.814
62.1	33	2	Nannofossil chalk	312.25	1.75	56.9	1.809	3166	67.161	0.358	4.414	0.985	3.758	0.396	0.750
62.1	33	3	Nannofossil chalk	313.75	1.77	55.9	1.678	2966	66.174	0.393	4.512	0.446	4.215	0.452	0.502
62.1	34	1	Nannofossil chalk	320.75	1.73	57.9	1.818	3152	66.350	0.327	4.322	1.195	3.525	0.373	0.830
62.1	34	2	Nannofossil chalk	322.25	1.81	53.6	1.805	3260	67.689	0.489	4.768	0.872	4.187	0.414	0.695
62.1	34	3	Nannofossil chalk	323.75	1.79	54.5	1.818	3256	65.046	0.448	4.656	1.095	3.926	0.391	0.782
62.1	34	4	Nannofossil chalk	325.25	1.80	54.2	1.791	3219	66.844	0.464	4.701	1.207	3.896	0.382	0.820
62.1	34	5	Nannofossil chalk	326.75	1.84	51.9	1.926	3534	67.865	0.572	4.970	1.805	3.767	0.338	0.992
62.1	34	6	Nannofossil chalk	328.25	1.83	52.0	1.829	3353	68.324	0.568	4.962	1.132	4.207	0.394	0.786
62.1	35	1	Nannofossil chalk	327.75	1.71	59.2	1.591	2722	65.011	0.289	4.201	0.135	4.111	0.484	0.280
62.1	35	2	Nannofossil chalk	329.25	1.71	59.1	1.813	3101	67.055	0.292	4.215	1.165	3.438	0.373	0.825
62.1	35	3	Nannofossil chalk	330.75	1.74	57.5	1.757	3059	67.513	0.340	4.363	0.921	3.749	0.401	0.727
62.1	35	4	Nannofossil chalk	332.25	1.75	57.2	1.807	3155	67.161	0.350	4.392	0.982	3.738	0.396	0.750
62.1	35	5	Nannofossil chalk	333.75	1.73	58.3	1.771	3057	65.892	0.314	4.281	0.849	3.715	0.407	0.701

Table 3. Site 63

63.0	1	1	Pelagic clay	.75	1.42	76.7	1.446	2050	38.969	0.057	3.118	0.000	3.118	0.500	0.000
63.0	1	2	Pelagic clay	2.25	1.41	77.0	1.477	2086	40.519	0.055	3.106	0.028	3.088	0.496	0.140
63.0	1	3	Calcareous pelagic clay	3.75	1.45	74.8	1.462	2117	41.435	0.067	3.200	0.000	3.200	0.500	0.000
63.0	1	4	Calcareous pelagic clay	5.25	1.38	79.2	1.456	2002	41.929	0.045	3.020	0.000	3.020	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification			Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
Hole	Core	Section													
63.0	2	2	Nannofossil chalk ooze	63.25	1.63	64.2	1.563	2543	61.311	0.181	3.812	0.203	3.677	0.474	0.353
63.0	2	3	Nannofossil chalk ooze	64.75	1.69	60.8	1.554	2619	66.244	0.251	4.077	0.026	4.060	0.497	0.123
63.0	2	4	Nannofossil chalk ooze	66.25	1.63	64.2	1.546	2516	65.751	0.182	3.822	0.101	3.754	0.487	0.250
63.0	2	5	Nannofossil chalk ooze	67.75	1.67	61.4	1.550	2594	66.244	0.236	4.025	0.030	4.000	0.495	0.149
63.0	2	6	Nannofossil chalk ooze	69.25	1.70	59.9	1.552	2636	59.196	0.271	4.130	0.030	4.106	0.496	0.144
63.0	3	2	Nannofossil chalk ooze	139.25	1.72	58.9	1.576	2706	60.254	0.299	4.223	0.030	4.202	0.496	0.135
63.0	3	3	Nannofossil chalk ooze	140.75	1.73	58.1	1.615	2794	65.575	0.320	4.301	0.230	4.147	0.474	0.365
63.0	3	4	Nannofossil marl ooze	142.25	1.71	59.3	1.720	2943	57.646	0.288	4.182	1.020	3.502	0.387	0.773
63.0	4	1	Nannofossil chalk ooze	230.75	1.80	54.3	1.777	3190	64.623	0.460	4.684	0.950	4.047	0.405	0.730
63.0	4	2	Nannofossil chalk ooze	232.25	1.88	49.4	1.952	3664	65.117	0.723	5.299	2.180	3.841	0.319	1.079
63.0	5	1	Nannofossil chalk	252.75	1.81	53.3	1.524	2760	64.694	0.501	4.789	0.000	4.789	0.500	0.000
63.0	5	2	Nannofossil chalk	354.25	1.91	47.5	2.110	4027	66.103	0.865	5.596	4.125	2.846	0.204	1.470
63.0	6	1	Nannofossil chalk	458.75	1.94	45.7	1.692	3281	68.923	1.023	5.917	0.000	5.917	0.500	0.000
63.0	6	2	Nannofossil chalk	460.25	1.90	47.9	1.697	3230	69.627	0.834	5.549	0.022	5.535	0.498	0.106
63.0	6	3	Nannofossil chalk	461.75	1.96	44.6	1.640	3212	69.416	1.138	6.135	0.000	6.135	0.500	0.000
63.0	6	4	Nannofossil chalk	463.25	1.95	45.3	1.737	3382	70.861	1.066	6.007	0.000	6.007	0.500	0.000
63.0	6	5	Nannofossil chalk	464.75	1.97	43.6	1.597	3152	69.416	1.240	6.320	0.000	6.320	0.500	0.000
63.0	6	6	Nannofossil chalk	466.25	1.96	44.5	1.736	3401	72.165	1.139	6.150	0.000	6.150	0.500	0.000
63.0	7	1	Nannofossil chalk	534.75	1.97	44.0	1.778	3499	68.429	1.200	6.243	0.138	6.151	0.489	0.264
63.0	7	2	Nannofossil chalk	536.25	1.97	44.2	1.776	3490	69.134	1.179	6.208	0.399	5.942	0.469	0.451
63.0	7	3	Nannofossil chalk	537.75	2.01	41.7	1.768	3548	68.112	1.484	6.734	0.000	6.734	0.500	0.000
63.0	7	4	Nannofossil chalk	539.25	2.01	41.3	1.719	3461	68.535	1.542	6.835	0.000	6.835	0.500	0.000
63.0	7	5	Nannofossil chalk	540.75	2.04	39.9	1.791	3648	68.711	1.750	7.177	0.000	7.177	0.500	0.000
63.0	7	6	Nannofossil chalk	542.25	2.05	39.3	1.701	3483	70.826	1.865	7.377	0.000	7.377	0.500	0.000
63.0	8	2	Nannofossil chalk	545.25	1.99	43.8	1.786	3562	69.099	1.219	6.279	0.115	6.203	0.491	0.240
63.0	8	3	Nannofossil chalk	546.75	2.02	42.4	1.854	3743	67.654	1.396	6.582	0.628	6.163	0.454	0.558

63.0	9	1	Nannofossil chalk	553.75	2.08	38.8	1.872	3896	69.874	1.951	7.505	0.379	7.252	0.475	0.427
63.0	9	2	Nannofossil chalk	555.25	2.11	38.5	1.872	3952	69.980	2.010	7.598	0.458	7.292	0.470	0.466
63.0	9	3	Nannofossil chalk	556.75	2.16	35.9	1.917	4133	70.050	2.554	8.416	0.149	8.316	0.491	0.263
63.0	9	4	Nannofossil chalk	558.25	2.17	35.3	2.103	4555	69.099	2.696	8.610	2.415	7.000	0.372	1.056
63.1	3	2	Calcareous pelagic clay	24.25	1.40	77.6	1.416	1984	48.166	0.052	3.090	0.000	3.090	0.500	0.000
63.1	5	1	Nannofossil chalk ooze	101.75	1.55	69.1	1.438	2222	59.690	0.115	3.509	0.000	3.509	0.500	0.000
63.1	5	2	Nannofossil chalk ooze	103.25	1.61	65.2	1.435	2311	59.901	0.166	3.746	0.000	3.746	0.500	0.000
63.1	5	3	Nannofossil chalk ooze	104.75	1.62	64.7	1.437	2327	62.791	0.173	3.783	0.000	3.783	0.500	0.000
63.1	5	4	Nannofossil marl ooze	106.25	1.57	67.6	1.490	2339	53.664	0.132	3.587	0.000	3.587	0.500	0.000
63.1	6	2	Nannofossil marl ooze	112.25	1.52	70.7	1.451	2204	50.527	0.099	3.413	0.000	3.413	0.500	0.000
63.1	6	3	Nannofossil marl ooze	113.75	1.53	70.3	1.427	2176	53.734	0.103	3.438	0.000	3.438	0.500	0.000
63.1	6	4	Nannofossil marl ooze	115.25	1.54	69.3	1.432	2209	56.483	0.113	3.495	0.000	3.495	0.500	0.000
63.1	6	5	Nannofossil marl ooze	116.75	1.57	67.4	1.437	2261	53.382	0.135	3.602	0.000	3.602	0.500	0.000
63.1	6	6	Nannofossil marl ooze	118.25	1.62	64.4	1.460	2371	57.012	0.178	3.792	0.000	3.792	0.500	0.000
63.1	7	3	Marl ooze	122.75	1.53	69.9	1.461	2237	57.611	0.107	3.463	0.000	3.463	0.500	0.000
63.1	7	4	Marl ooze	124.25	1.53	70.0	1.470	2249	53.523	0.106	3.453	0.000	3.453	0.500	0.000
63.1	8	4	Nannofossil chalk ooze	134.25	1.38	79.2	1.453	1998	59.831	0.045	3.035	0.000	3.035	0.500	0.000
63.1	8	5	Nannofossil marl ooze	135.75	1.42	76.8	1.473	2086	58.597	0.056	3.135	0.000	3.135	0.500	0.016
63.1	9	3	Nannofossil chalk	141.75	1.66	62.1	1.534	2552	65.046	0.221	3.972	0.033	3.950	0.496	0.141
63.1	9	4	Nannofossil chalk	143.25	1.75	56.9	1.457	2551	62.826	0.361	4.412	0.000	4.412	0.500	0.000
63.1	9	5	Nannofossil chalk	144.75	1.70	60.1	1.472	2497	60.077	0.266	4.116	0.000	4.116	0.500	0.000
63.1	9	6	Nannofossil chalk	146.25	1.73	58.3	1.522	2629	66.280	0.316	4.289	0.000	4.289	0.500	0.000
63.1	10	1	Nannofossil chalk	148.75	1.71	59.6	1.496	2551	62.509	0.279	4.164	0.000	4.164	0.500	0.000
63.1	10	2	Nannofossil marl	150.25	1.72	58.6	1.501	2586	56.483	0.308	4.239	0.000	4.239	0.500	0.000
63.1	10	3	Nannofossil chalk	151.75	1.67	61.7	1.497	2498	62.967	0.229	3.995	0.000	3.995	0.500	0.000
63.1	10	4	Nannofossil chalk	153.25	1.75	57.0	1.541	2696	60.677	0.356	4.394	0.000	4.394	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

Identification															
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
63.1	10	5	Nannofossil chalk	154.75	1.76	56.6	1.474	2587	65.751	0.369	4.443	0.000	4.443	0.500	0.000
63.1	11	1	Nannofossil chalk	155.75	1.70	59.6	1.486	2533	66.632	0.278	4.170	0.000	4.170	0.500	0.000
63.1	11	2	Nannofossil chalk	157.25	1.66	62.5	1.470	2436	60.817	0.214	3.938	0.000	3.938	0.500	0.000
63.1	11	3	Nannofossil chalk	158.75	1.73	58.2	1.496	2587	62.579	0.319	4.289	0.000	4.289	0.500	0.000
63.1	11	4	Nannofossil chalk	160.25	1.76	56.3	1.504	2647	65.187	0.379	4.471	0.000	4.471	0.500	0.000
63.1	11	5	Nannofossil chalk	161.75	1.76	56.1	1.541	2719	66.808	0.388	4.499	0.141	4.405	0.485	0.283
63.1	11	6	Nannofossil chalk	163.25	1.79	54.4	1.615	2896	62.579	0.455	4.666	0.511	4.325	0.447	0.534
63.1	12	1	Nannofossil chalk	165.75	1.76	56.1	1.726	3045							
63.1	12	2	Nannofossil chalk	167.25	1.80	54.1	1.637	2941	66.632	0.465	4.704	0.111	4.630	0.488	0.248
63.1	13	1	Nannofossil chalk	174.75	1.75	57.2	1.590	2775	64.659	0.348	4.380	0.369	4.134	0.459	0.460
63.1	13	2	Nannofossil chalk	176.25	1.68	60.9	1.603	2699	63.742	0.248	4.063	0.543	3.701	0.436	0.568
63.1	13	3	Nannofossil chalk	177.75	1.77	55.7	1.651	2924	65.187	0.403	4.537	0.768	4.025	0.420	0.658
63.1	13	4	Nannofossil chalk	179.25	1.64	63.3	1.635	2685	63.179	0.345	4.367	0.853	3.798	0.408	0.699
63.1	13	5	Nannofossil chalk	180.75	1.74	57.4	1.613	2812	59.126	0.197	3.871	0.589	3.479	0.428	0.599
63.1	13	6	Nannofossil marl	182.25	1.62	64.7	1.576	2552	54.016	0.173	3.766	0.772	3.252	0.404	0.690
63.1	14	1	Nannofossil chalk	184.75	1.69	60.8	1.535	2586	61.663	0.249	4.065	0.309	3.859	0.463	0.428
63.1	14	2	Nannofossil chalk	186.25	1.78	55.4	1.534	2725	65.998	0.414	4.567	0.000	4.567	0.500	0.000
63.1	14	3	Nannofossil chalk	187.75	1.72	58.6	1.681	2895	63.707	0.307	4.254	0.842	3.692	0.407	0.699
63.1	14	4	Nannofossil marl	189.25	1.75	57.0	1.566	2738	58.174	0.356	4.387	0.264	4.212	0.471	0.388
63.1	14	5	Nannofossil chalk	190.75	1.79	54.5	1.545	2767	67.020	0.449	4.662	0.000	4.662	0.500	0.000
63.1	14	6	Nannofossil chalk	192.25	1.79	54.8	1.551	2769							
63.2	1	1	Calcareous pelagic clay	11.75	1.32	82.5	1.379	1819							
63.2	1	2	Calcareous pelagic clay	13.25	1.39	78.3	1.392	1935							
63.2	1	3	Calcareous pelagic clay	14.75	1.37	79.4	1.364	1870	47.180	0.044	3.017	0.000	3.017	0.500	0.000
63.2	1	4	Calcareous pelagic clay	16.25	1.32	82.3	1.379	1823	43.973	0.034	2.908	0.000	2.908	0.500	0.000

63.2	2	1	Calcareous pelagic clay	20.75	1.36	80.1	1.330	1808	39.779	0.041	2.983	0.000	2.983	0.500	0.000
63.2	2	2	Calcareous pelagic clay	22.25	1.32	82.5	1.374	1811	47.497	0.033	2.902	0.000	2.902	0.500	0.000
63.2	2	3	Calcareous pelagic clay	23.75	1.30	83.8	1.416	1838	43.797	0.029	2.857	0.000	2.857	0.500	0.000
63.2	2	4	Calcareous pelagic clay	25.25	1.30	83.9	1.364	1768	45.136	0.029	2.855	0.000	2.855	0.500	0.000
63.2	3	1	Calcareous pelagic clay	30.75	1.35	80.5	1.434	1940	43.691	0.040	2.974	0.000	2.974	0.500	0.000
63.2	3	2	Calcareous pelagic clay	32.25	1.39	78.3	1.387	1928	42.669	0.049	3.057	0.000	3.057	0.500	0.000
63.2	3	3	Nannofossil marl ooze	33.75	1.46	74.2	1.406	2050	56.095	0.071	3.245	0.000	3.245	0.500	0.000
63.2	3	4	Nannofossil marl ooze	35.25	1.55	68.7	1.405	2181	56.800	0.120	3.530	0.000	3.530	0.500	0.000

Table 4. Site 64

64.0	1	3	Foraminiferal nanno-fossil chalk ooze	3.75	1.50	71.9	1.441	2159	66.103	0.089	3.369	0.000	3.369	0.500	0.000
64.0	1	4	Foraminiferal nanno-fossil chalk ooze	5.25	1.51	71.3	1.445	2179	65.117	0.094	3.397	0.000	3.397	0.500	0.000
64.0	1	5	Foraminiferal nanno-fossil chalk ooze	6.75	1.51	71.5	1.433	2156	66.808	0.092	3.391	0.000	3.391	0.500	0.000
64.0	2	1	Foraminiferal nanno-fossil chalk ooze	99.75	1.61	65.5	1.455	2337	68.218	0.161	3.738	0.000	3.738	0.500	0.000
64.2	2	2	Foraminiferal nanno-fossil chalk ooze	101.25	1.60	66.0	1.452	2319	68.887	0.153	3.705	0.000	3.705	0.500	0.000
64.0	2	4	Foraminiferal nanno-fossil chalk ooze	104.25	1.66	62.2	1.462	2430							
64.0	2	5	Foraminiferal nanno-fossil chalk ooze	105.75	1.68	61.1	1.483	2491							
64.0	2	6	Foraminiferal nanno-fossil chalk ooze	107.25	1.67	61.9	1.459	2432	69.768	0.226	3.994	0.000	3.994	0.500	0.000
64.0	3	1	Nannofossil chalk ooze	202.75	1.69	60.6	1.488	2511	70.368	0.254	4.095	0.000	4.095	0.500	0.000
64.0	3	2	Nannofossil chalk ooze	204.25	1.72	59.0	1.529	2622	71.354	0.294	4.230	0.000	4.230	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification															
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
64.0	3	3	Nannofossil chalk ooze	205.75	1.72	58.8	1.476	2537	68.042	0.302	4.247	0.000	4.247	0.500	0.000
64.0	3	4	Nannofossil chalk ooze	207.25	1.69	60.8	1.480	2494	70.508	0.249	4.081	0.000	4.081	0.500	0.000
64.0	3	5	Nannofossil chalk ooze	208.75	1.71	59.5	1.486	2537	69.980	0.282	4.187	0.000	4.187	0.500	0.000
64.0	3	6	Nannofossil chalk ooze	210.25	1.70	59.7	1.506	2564	68.570	0.276	4.165	0.000	4.165	0.500	0.000
64.0	4	2	Nannofossil chalk ooze	306.25	1.67	61.5	1.504	2518	68.817	0.234	4.025	0.000	4.025	0.500	0.000
64.0	4	3	Nannofossil chalk ooze	307.75	1.72	59.0	1.507	2585	67.513	0.294	4.224	0.000	4.224	0.500	0.000
64.0	4	4	Nannofossil chalk ooze	309.25	1.71	59.4	1.518	2592	62.720	0.284	4.182	0.000	4.182	0.500	0.000
64.0	4	5	Nannofossil chalk ooze	310.75	1.71	59.2	1.530	2619	68.359	0.290	4.212	0.000	4.212	0.500	0.000
64.0	4	6	Nannofossil chalk ooze	312.25	1.72	58.5	1.566	2699	69.768	0.310	4.277	0.073	4.228	0.492	0.206
64.0	5	1	Nannofossil chalk ooze	409.75	1.75	57.2	1.539	2687	69.592	0.351	4.399	0.000	4.399	0.518	0.000
64.0	5	2	Nannofossil chalk ooze	411.25	1.71	59.1	1.661	2847	68.112	0.294	4.223	0.618	3.811	0.430	0.601
64.0	5	3	Nannofossil chalk ooze	412.75	1.71	59.2	1.544	2643							
64.0	5	4	Nannofossil chalk ooze	414.25	1.75	57.1	1.582	2766	68.817	0.354	4.407	0 047	4.376	0.495	0.164
64.0	5	5	Nannofossil chalk ooze	415.75	1.78	55.4	1.616	2869	67.161	0.413	4.569	0.129	4.483	0.486	0.270
64.0	5	6	Nannofossil chalk ooze	417.25	1.76	56.3	1.646	2896							
64.0	6	1	Nannofossil marl ooze	505.75	1.79	54.4	1.626	2918	53.769	0.456	4.638	0.247	4.473	0.474	0.371
64.0	6	2	Nannofossil chalk ooze	507.25	1.80	54.0	1.633	2939	66.209	0.472	4.721	0.238	4.563	0.475	0.363
64.0	6	3	Nannofossil chalk ooze	508.75	1.79	54.4	1.661	2978	69.698	0.455	4.686	0.362	4.445	0.462	0.450
64.0	6	4	Nannofossil chalk ooze	510.25	1.83	52.5	1.680	3067	68.923	0.542	4.902	0.275	4.719	0.473	0.388
64.0	6	5	Nannofossil chalk ooze	511.75	1.84	51.7	1.675	3079	64.236	0.583	4.983	0.205	4.846	0.480	0.334
64.0	6	6	Nannofossil chalk ooze	513.25	1.85	50.8	1.758	3258							
64.0	7	2	Nannofossil chalk	612.25	1.78	55.4	1.616	2868	68.006	0.412	4.568	0.417	4.290	0.456	0.485
64.0	7	3	Nannofossil chalk	613.75	1.76	56.2	1.592	2805	68.324	0.383	4.489	0.042	4.461	0.495	0.154
64.0	7	4	Nannofossil chalk	615.25	1.79	54.8	1.663	2968	68.923	0.436	4.633	0.331	4.413	0.465	0.430
64.0	7	5	Nannofossil chalk	616.75	1.74	57.5	1.606	2794	69.205	0.339	4.364	0.169	4.251	0.481	0.312

64.0	7	6	Nannofossil chalk	618.25	1.72	58.6	1.657	2853	69.768	0.307	4.266	0.372	4.018	0.458	0.465
64.0	8	2	Nannofossil chalk	707.25	1.92	47.1	1.902	3645	67.971	0.898	5.671	1.455	4.701	0.382	0.871
64.0	8	3	Nannofossil chalk	708.75	1.92	46.9	1.949	3741	68.042	0.915	5.704	1.997	4.373	0.343	1.020
64.0	10	1	Nannofossil chalk and limestone	848.75	1.87	50.1	1.941	3621	68.676	0.681	5.221	1.510	4.215	0.368	0.900
64.0	10	2	Nannofossil chalk and limestone	850.25	1.95	45.2	2.073	4037	67.478	1.068	5.995	2.831	4.108	0.296	1.206
64.1	1	1	Nannofossil chalk ooze	433.75	1.79	54.6	1.609	2879	69.663	0.445	4.659	0.006	4.655	0.499	0.057
64.1	1	2	Nannofossil chalk ooze	435.25	1.78	55.0	1.606	2862	65.786	0.428	4.606	0.032	4.585	0.497	0.133
64.1	1	3	Nannofossil chalk ooze	436.75	1.77	55.9	1.626	2874	62.121	0.393	4.501	0.233	4.346	0.475	0.363
64.1	1	4	Nannofossil chalk ooze	438.25	1.78	55.1	1.656	2949	69.451	0.424	4.604	0.254	4.434	0.473	0.378
64.1	1	5	Nannofossil chalk ooze	439.75	1.81	53.2	1.602	2904	69.698	0.508	4.821	0.000	4.821	0.500	0.000
64.1	1	6	Nannofossil chalk ooze	441.25	1.76	56.6	1.609	2825	68.147	0.371	4.454	0.168	4.342	0.481	0.309
64.1	2	2	Nannofossil chalk and chalk ooze	444.25	1.74	57.4	1.594	2776	67.654	0.342	4.369	0.068	4.325	0.492	0.197
64.1	2	3	Nannofossil chalk and chalk ooze	445.75	1.79	54.7	1.583	2829	66.597	0.440	4.638	0.000	4.638	0.500	0.000
64.1	2	4	Nannofossil chalk and chalk ooze	447.25	1.82	53.1	1.657	3007	68.923	0.514	4.833	0.213	4.691	0.478	0.342
64.1	2	5	Nannofossil chalk and chalk ooze	448.75	1.79	54.4	1.626	2915	68.923	0.456	4.685	0.063	4.643	0.493	0.188
64.1	2	6	Nannofossil chalk and chalk ooze	450.25	1.81	53.2	1.613	2923	69.945	0.506	4.815	0.000	4.815	0.500	0.000
64.1	3	1	Nannofossil chalk and chalk ooze	451.75	1.82	53.1	1.580	2868	69.169	0.512	4.829	0.000	4.829	0.500	0.000
64.1	3	2	Nannofossil chalk and chalk ooze	453.25	1.77	55.5	1.571	2787	68.500	0.409	4.559	0.000	4.559	0.500	0.000
64.1	3	4	Nannofossil chalk and chalk ooze	456.25	1.81	53.6	1.621	2929	69.275	0.491	4.777	0.085	4.721	0.491	0.216

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm$^2 \times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm$^2 \times 10^{10}$; K = bulk modulus sediment, dynes/cm$^2 \times 10^{10}$; μ = rigidity, dynes/cm$^2 \times 10^{10}$; λ = Lame's constant, dynes/cm$^2 \times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Hole	Lithology Core	Lithology Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
64.1	3	5	Nannofossil chalk and chalk ooze	457.75	1.77	55.6	1.641	2909	70.438	0.407	4.560	0.178	4.442	0.481	0.317
64.1	4	1	Nannofossil chalk and chalk ooze	461.75	1.75	56.8	1.595	2794	68.218	0.362	4.428	0.270	4.248	0.470	0.392
64.1	4	2	Nannofossil chalk and chalk ooze	463.25	1.76	56.2	1.580	2786	69.522	0.384	4.493	0.019	4.481	0.498	0.104
64.1	4	3	Nannofossil chalk and chalk ooze	464.75	1.77	55.8	1.617	2861							
64.1	4	4	Nannofossil chalk and chalk ooze	466.25	1.76	56.6	1.555	2731	68.183	0.370	4.451	0.000	4.451	0.500	0.000
64.1	4	5	Nannofossil chalk and chalk ooze	467.75	1.80	54.0	1.697	3052	67.302	0.469	4.717	0.454	4.414	0.453	0.502
64.1	4	6	Nannofossil chalk and chalk ooze	469.25	1.82	52.8	1.727	3144	68.535	0.527	4.864	0.575	4.481	0.443	0.562
64.1	5	2	Nannofossil chalk and chalk ooze	472.25	1.77	55.6	1.526	2704	67.654	0.404	4.545	0.000	4.545	0.500	0.000
64.1	5	3	Nannofossil chalk and chalk ooze	473.75	1.80	54.0	1.569	2822	67.936	0.469	4.718	0.000	4.718	0.500	0.000
64.1	5	4	Nannofossil chalk and chalk ooze	475.25	1.83	52.3	1.549	2831	69.487	0.552	4.927	0.000	4.927	0.500	0.000
64.1	5	5	Nannofossil chalk and chalk ooze	476.75	1.85	50.9	1.567	2901	70.227	0.630	5.112	0.000	5.112	0.500	0.000
64.1	5	6	Nannofossil chalk and chalk ooze	478.25	1.83	52.4	1.585	2896	68.923	0.550	4.920	0.000	4.920	0.500	0.000
64.1	6	1	Nannofossil chalk and limestone	565.75	1.85	51.2	1.710	3158	68.923	0.611	5.065	0.333	4.843	0.468	0.425
64.1	6	2	Nannofossil chalk and limestone	567.25	1.82	52.9	1.702	3094	68.535	0.523	4.853	0.399	4.588	0.460	0.468

64.1	6	3	Nannofossil chalk and limestone	568.75	1.82	52.6	1.762	3211	68.394	0.535	4.882	0.692	4.421	0.432	0.616
64.1	6	4	Nannofossil chalk and limestone	570.25	1.83	52.1	1.749	3204	69.980	0.563	4.956	0.612	4.548	0.441	0.578
64.1	7	2	Nannofossil chalk and limestone	663.25	1.84	51.6	1.699	3124	66.244	0.587	5.000	0.340	4.773	0.467	0.430
64.1	7	3	Nannofossil chalk and limestone	664.75	1.84	51.5	1.726	3178	67.407	0.593	5.017	0.408	4.745	0.460	0.471
64.1	7	4	Nannofossil chalk and limestone	666.25	1.81	53.6	1.718	3104	69.698	0.490	4.775	0.722	4.294	0.428	0.632
64.1	8	2	Nannofossil chalk	748.25	1.89	48.7	1.880	3551	69.169	0.774	5.422	1.183	4.634	0.398	0.791
64.1	9	1	Nannofossil chalk	911.75	1.85	51	1.780	3290	68.394	0.617	5.076	0.850	4.509	0.421	0.678
64.1	9	2	Nannofossil chalk	913.25	1.84	51.5	1.723	3173	70.121	0.595	5.029	0.459	4.724	0.456	0.499
64.1	9	3	Nannofossil chalk	914.75	1.88	49.0	1.768	3330	70.156	0.752	5.379	0.483	5.058	0.456	0.506
64.1	10	1	Nannofossil chalk	969.75	1.84	51.7	1.802	3314	66.808	0.586	4.998	0.916	4.388	0.414	0.706
64.1	10	2	Nannofossil chalk	971.25	1.88	49.4	1.790	3358	67.302	0.721	5.302	0.572	4.920	0.448	0.552

Table 5. Site 65

65.0	2	2	Radiolarian ooze	12.25	1.14	91.2	1.473	1678	34.600	0.005	2.614	0.000	2.614	0.500	0.000
65.0	2	3	Radiolarian ooze	13.75	1.14	90.9	1.479	1692	34.600	0.005	2.624	0.000	2.624	0.500	0.000
65.0	2	4	Radiolarian ooze	15.25	1.14	91.6	1.467	1665	34.600	0.004	2.605	0.000	2.605	0.500	0.000
65.0	2	5	Radiolarian ooze	16.75	1.14	91.1	1.502	1714	34.600	0.005	2.617	0 000	2.617	0.500	0.000
65.0	3	1	Radiolarian ooze	19.75	1.15	90.7	1.492	1709	34.600	0.005	2.627	0.000	2.627	0.500	0.000
65.0	3	2	Radiolarian ooze	21.25	1.14	91.2	1.478	1683	34.600	0.005	2.616	0.000	2.616	0.500	0.000
65.0	3	3	Radiolarian ooze	22.75	1.14	91.2	1.475	1680	34.600	0.005	2.616	0.000	2.616	0.500	0.000
65.0	3	4	Radiolarian ooze	24.25	1.16	90.0	1.469	1697	34.600	0.005	2.648	0.000	2.648	0.500	0.000
65.0	3	5	Radiolarian ooze	25.75	1.15	90.1	1.467	1691	34.600	0.005	2.644	0.000	2.644	0.500	0.000
65.0	5	2	Radiolarian ooze	39.25	1.15	89.8	1.489	1718	34.600	0.005	2.653	0.000	2.653	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification															
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
65.0	5	3	Radiolarian ooze	40.75	1.15	89.9	1.467	1691							
65.0	5	4	Radiolarian ooze	42.25	1.16	89.4	1.454	1685	34.600	0.005	2.663	0.000	2.663	0.500	0.000
65.0	5	5	Radiolarian ooze	43.75	1.14	90.8	1.464	1672	34.600	0.005	2.627	0.000	2.627	0.500	0.000
65.0	6	2	Radiolarian ooze	48.25	1.15	89.9	1.480	1703	34.600	0.005	2.651	0.000	2.651	0.500	0.000
65.0	7	2	Radiolarian ooze	57.25	1.16	89.1	1.474	1710	34.600	0.005	2.673	0.000	2.673	0.500	0.000
65.0	7	3	Radiolarian ooze	58.75	1.17	88.4	1.486	1737	34.600	0.006	2.694	0.000	2.694	0.500	0.000
65.0	7	4	Radiolarian ooze	60.25	1.15	90.3	1.478	1693	34.600	0.005	2.640	0.000	2.640	0.500	0.000
65.0	7	5	Radiolarian ooze	61.75	1.14	91.1	1.468	1667	34.600	0.005	2.618	0.000	2.618	0.500	0.000
65.0	8	1	Radiolarian ooze	64.75	1.18	87.2	1.460	1728	34.600	0.007	2.728	0.000	2.728	0.500	0.000
65.0	8	2	Radiolarian ooze	66.25	1.19	86.9	1.474	1749	34.600	0.007	2.735	0.000	2.735	0.500	0.000
65.0	8	3	Radiolarian ooze	67.75	1.21	84.7	1.473	1786	34.600	0.009	2.803	0.000	2.803	0.500	0.000
65.0	8	4	Radiolarian ooze	69.25	1.17	88.4	1.468	1714	34.600	0.006	2.691	0.000	2.691	0.500	0.000
65.0	8	5	Radiolarian ooze	70.75	1.20	85.5	1.473	1772	34.600	0.008	2.776	0.000	2.776	0.500	0.000
65.0	8	6	Radiolarian ooze	72.25	1.19	86.4	1.482	1766	34.600	0.007	2.752	0.000	2.752	0.500	0.000
65.0	9	1	Radiolarian ooze	74.75	1.22	84.3	1.448	1762	34.600	0.009	2.813	0.000	2.813	0.500	0.000
65.0	9	2	Radiolarian ooze	76.25	1.21	85.0	1.459	1761	34.600	0.008	2.792	0.000	2.792	0.500	0.000
65.0	9	3	Radiolarian ooze	77.75	1.21	84.5	1.483	1800	34.600	0.009	2.808	0.000	2.808	0.500	0.000
65.0	9	4	Radiolarian ooze	79.25	1.19	86.7	1.484	1762							
65.0	9	5	Radiolarian ooze	80.75	1.21	85.3	1.456	1754	34.600	0.008	2.785	0.000	2.785	0.500	0.000
65.0	9	6	Radiolarian ooze	82.25	1.22	84.2	1.442	1755							
65.0	10	2	Radiolarian ooze	85.25	1.21	84.7	1.451	1756							
65.0	10	3	Radiolarian ooze	86.75	1.21	84.5	1.454	1763	34.600	0.009	2.809	0.000	2.809	0.500	0.000
65.0	10	4	Radiolarian ooze	88.25	1.21	84.7	1.472	1781	34.600	0.009	2.803	0.000	2.803	0.500	0.000
65.0	11	2	Radiolarian ooze	94.25	1.16	89.0	1.463	1693	34.600	0.006	2.677	0.000	2.677	0.500	0.000
65.0	11	3	Radiolarian ooze	95.75	1.16	88.7	1.487	1726	34.600	0.006	2.685	0.000	2.685	0.500	0.000

65.0	11	4	Radiolarian ooze	97.25	1.15	89.7	1.477	1697	34.600	0.005	2.657	0.000	2.657	0.500	0.000
65.0	11	5	Radiolarian ooze	98.75	1.13	91.3	1.470	1658	34.600	0.005	2.611	0.000	2.611	0.500	0.000
65.0	11	6	Radiolarian ooze	100.25	1.12	92.3	1.454	1623	34.600	0.004	2.584	0.000	2.584	0.500	0.000
65.0	12	1	Radiolarian ooze	101.75	1.10	93.7	1.483	1631	34.600	0.004	2.549	0.000	2.549	0.500	0.000
65.0	12	2	Radiolarian ooze	103.25	1.15	89.2	1.493	1720	34.600	0.006	2.669	0.000	2.669	0.500	0.000
65.0	12	3	Radiolarian ooze	104.75	1.16	89.0	1.500	1732	34.600	0.006	2.676	0.000	2.676	0.500	0.000
65.0	12	4	Radiolarian ooze	106.25	1.23	82.8	1.437	1765	34.600	0.010	2.863	0.000	2.863	0.500	0.000
65.0	12	5	Radiolarian ooze	107.75	1.17	87.8	1.492	1743	34.600	0.006	2.709	0.000	2.709	0.500	0.000
65.0	12	6	Radiolarian ooze	109.25	1.15	89.1	1.491	1720	34.600	0.006	2.673	0.000	2.673	0.500	0.000
65.0	13	1	Radiolarian ooze	110.75	1.12	92.0	1.499	1678	34.600	0.004	2.594	0.000	2.594	0.500	0.000
65.0	13	2	Radiolarian ooze	112.25	1.13	91.2	1.491	1680	34.600	0.005	2.615	0.000	2.615	0.500	0.000
65.0	13	3	Radiolarian ooze	113.75	1.15	88.8	1.527	1762	34.600	0.006	2.680	0.016	2.670	0.497	0.117
65.0	13	4	Radiolarian ooze	115.25	1.15	88.9	1.493	1723	34.600	0.006	2.678	0.000	2.678	0.500	0.000
65.0	13	5	Radiolarian ooze	116.75	1.16	88.4	1.492	1729	34.600	0.006	2.691	0.000	2.691	0.500	0.000
65.0	13	6	Radiolarian ooze	118.25	1.17	87.7	1.533	1791	34.600	0.006	2.713	0.053	2.678	0.490	0.214
65.0	14	1	Radiolarian ooze	119.75	1.16	88.5	1.486	1722	34.600	0.006	2.691	0.000	2.691	0.500	0.000
65.0	14	2	Radiolarian ooze	121.25	1.18	86.0	1.505	1780	34.600	0.008	2.763	0.000	2.763	0.500	0.000
65.0	14	3	Radiolarian ooze	122.75	1.24	80.6	1.514	1883	34.600	0.013	2.936	0.000	2.936	0.500	0.000
65.0	14	4	Calcareous radiolarian ooze	124.25	1.29	76.9	1.490	1917	34.600	0.019	3.070	0.000	3.070	0.500	0.000
65.0	14	5	Nannofossil radiolarian ooze	125.75	1.32	74.2	1.464	1928	34.600	0.024	3.173	0.000	3.173	0.500	0.000
65.0	14	6	Nannofossil radiolarian ooze	127.25	1.39	68.1	1.460	2025	34.600	0.044	3.446	0.000	3.446	0.500	0.000
65.0	16	3	Nannofossil radiolarian ooze	140.75	1.27	77.3	1.508	1919	34.600	0.018	3.055	0.000	3.055	0.500	0.000
65.0	16	4	Nannofossil radiolarian ooze	142.25	1.21	82.7	1.488	1807	34.600	0.011	2.866	0.000	2.866	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification															
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
65.0	16	5	Nannofossil radio-larian ooze	143.75	1.19	85.2	1.476	1751	34.600	0.008	2.786	0.000	2.786	0.500	0.000
65.0	16	6	Nannofossil radio-larian ooze	145.25	1.20	84.2	1.492	1787	34.600	0.009	2.819	0.000	2.819	0.500	0.000
65.1	4	1	Radiolarian ooze	154.75	1.17	86.5	1.495	1747	34.600	0.007	2.748	0.000	2.748	0.500	0.000
65.1	4	2	Radiolarian ooze	156.25	1.19	83.9	1.494	1778	34.600	0.009	2.826	0.000	2.826	0.500	0.000
65.1	4	3	Radiolarian ooze	157.75	1.20	83.4	1.514	1810	34.600	0.010	2.845	0.000	2.845	0.500	0.000
65.1	4	4	Radiolarian ooze	159.25	1.20	83.3	1.528	1829	34.600	0.010	2.848	0.000	2.848	0.500	0.000
65.1	4	5	Radiolarian ooze	160.75	1.18	85.4	1.509	1773	34.600	0.008	2.780	0.000	2.780	0.500	0.000
65.1	4	6	Radiolarian ooze	162.25	1.17	86.2	1.516	1769	34.600	0.007	2.756	0.000	2.756	0.500	0.000
65.1	5	1	Radiolarian ooze with chert	162.75	1.23	79.9	1.486	1831	34.600	0.014	2.961	0.000	2.961	0.500	0.000
65.1	5	2	Radiolarian ooze with chert	164.25	1.18	84.6	1.507	1777	34.600	0.009	2.805	0.000	2.805	0.500	0.000
65.1	5	3	Radiolarian ooze with chert	165.75	1.19	83.2	1.509	1801	34.600	0.010	2.850	0.000	2.850	0.500	0.000
65.1	5	4	Radiolarian ooze with chert	167.25	1.20	82.1	1.502	1809	34.600	0.011	2.885	0.000	2.885	0.500	0.000

Table 6. Site 66

Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ	V_S
66.0	2	1	Radiolarian ooze	79.75	1.10	92.0	1.439	1588	34.600	0.004	2.592	0.000	2.592	0.500	0.000
66.0	2	2	Radiolarian ooze	81.25	1.12	92.7	1.443	1609	34.600	0.004	2.575	0.000	2.575	0.500	0.000
66.0	2	3	Radiolarian ooze	82.75	1.10	93.8	1.487	1639	34.600	0.004	2.548	0.000	2.548	0.500	0.000
66.0	3	1	Radiolarian ooze	117.75	1.17	88.1	1.495	1752	34.600	0.006	2.700	0.000	2.700	0.500	0.000
66.0	3	2	Radiolarian ooze	119.25	1.19	85.8	1.492	1779	34.600	0.008	2.768	0.000	2.768	0.500	0.000
66.0	3	3	Radiolarian ooze	120.75	1.18	87.0	1.501	1769	34.600	0.007	2.732	0.000	2.732	0.500	0.000
66.0	3	4	Radiolarian ooze	122.25	1.18	87.2	1.486	1748							

66.0	3	5	Radiolarian ooze	123.75	1.18	86.9	1.503	1772							
66.0	3	6	Radiolarian ooze	125.25	1.17	87.9	1.502	1754	34.600	0.006	2.708	0.000	2.708	0.500	0.000
66.0	6	2	Pelagic clay	167.25	1.52	70.8	1.416	2158	50.000	0.053	3.364	0.000	3.364	0.500	0.000
66.0	6	3	Pelagic clay	168.75	1.54	70.0	1.400	2153	50.000	0.057	3.404	0.000	3.404	0.500	0.000
66.0	6	4	Pelagic clay	170.25	1.58	67.9	1.427	2248	50.000	0.071	3.514	0.000	3.514	0.500	0.000
66.0	7	1	Pelagic clay	174.75	1.56	69.1	1.425	2216	50.000	0.063	3.453	0.000	3.453	0.500	0.000
66.0	7	2	Pelagic clay	176.25	1.62	65.8	1.450	2350	50.000	0.087	3.628	0.000	3.628	0.500	0.000
66.0	7	3	Pelagic clay	177.75	1.62	65.9	1.465	2371	50.000	0.086	3.622	0.000	3.622	0.500	0.000
66.0	7	4	Pelagic clay	179.25	1.64	64.9	1.451	2375	50.000	0.098	3.681	0.000	3.681	0.500	0.000
66.0	8	1	Pelagic clay	180.75	1.53	70.9	1.429	2187	50.000	0.053	3.360	0.000	3.360	0.500	0.000
66.0	8	2	Pelagic clay	182.25	1.51	72.6	1.419	2145	50.000	0.045	3.283	0.000	3.283	0.500	0.000
66.0	8	3	Pelagic clay	183.75	1.43	77.4	1.447	2063	50.000	0.028	3.080	0.000	3.080	0.500	0.000
66.0	8	4	Pelagic clay	185.25	1.38	79.9	1.440	1990	50.000	0.022	2.985	0.000	2.985	0.500	0.000
66.0	8	5	Pelagic clay	186.75	1.39	79.6	1.433	1986	50.000	0.022	2.994	0.000	2.994	0.500	0.000
66.0	9	1	Volcanic mud	187.75	1.45	76.2	1.357	1963	50.000	0.031	3.127	0.000	3.127	0.500	0.000
66.1	2	1	Radiolarian ooze	20.75	1.18	91.4	1.460	1727							
66.1	2	2	Radiolarian ooze	22.25	1.18	90.1	1.468	1727	34.600	0.005	2.644	0.000	2.644	0.500	0.000
66.1	2	3	Radiolarian ooze	23.75	1.17	90.9	1.428	1664	34.600	0.005	2.623	0.000	2.623	0.500	0.000
66.1	2	5	Radiolarian ooze	26.75	1.17	90.5	1.460	1711	34.600	0.005	2.634	0.000	2.634	0.500	0.000
66.1	2	6	Radiolarian ooze	28.25	1.16	91.2	1.462	1697	34.600	0.005	2.615	0.000	2.615	0.500	0.000
66.1	3	3	Radiolarian ooze	32.75	1.19	86.4	1.504	1785	34.600	0.007	2.751	0.000	2.751	0.500	0.000
66.1	4	2	Radiolarian ooze	40.25	1.18	88.1	1.495	1758	34.600	0.006	2.701	0.000	2.701	0.500	0.000
66.1	4	3	Radiolarian ooze	41.75	1.18	88.1	1.488	1750	34.600	0.006	2.701	0.000	2.701	0.500	0.000
66.1	6	2	Radiolarian ooze	58.25	1.17	88.9	1.475	1731	34.600	0.006	2.679	0.000	2.679	0.500	0.000
66.1	6	3	Radiolarian ooze	59.75	1.19	87.8	1.443	1714	34.600	0.006	2.710	0.000	2.710	0.500	0.000
66.1	6	4	Radiolarian ooze	61.25	1.20	86.7	1.477	1776	34.600	0.007	2.741	0.000	2.741	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

TABLES 1 through 6 – *Continued*

Identification														
Hole	Core	Section	Lithology	Depth*	ρ_B	ϕ	V_P	Acoustic Impedance	K_G	K_S	K	μ	λ	θ
66.1	6	5	Radiolarian ooze	62.75	1.19	87.3	1.466	1751	34.600	0.007	2.725	0.000	2.725	0.500	0.000
66.1	6	6	Radiolarian ooze	64.25	1.20	86.9	1.486	1783	34.600	0.007	2.735	0.000	2.735	0.500	0.000
66.1	7	1	Radiolarian ooze	67.75	1.15	90.3	1.472	1699	34.600	0.005	2.638	0.000	2.638	0.500	0.000
66.1	7	2	Radiolarian ooze	69.25	1.17	88.6	1.475	1724	34.600	0.006	2.687	0.000	2.687	0.500	0.000
66.1	7	3	Radiolarian ooze	70.75	1.20	85.9	1.473	1774	34.600	0.008	2.767	0.000	2.767	0.500	0.000
66.1	7	4	Radiolarian ooze	72.25	1.19	86.9	1.470	1751	34.600	0.007	2.735	0.000	2.735	0.500	0.000
66.1	7	5	Radiolarian ooze	73.75	1.22	85.0	1.472	1789	34.600	0.008	2.793	0.000	2.793	0.500	0.000
66.1	7	6	Radiolarian ooze	75.25	1.17	88.7	1.467	1713	34.600	0.006	2.684	0.000	2.684	0.500	0.000
66.1	8	1	Radiolarian ooze	76.75	1.19	86.8	1.489	1775	34.600	0.007	2.738	0.000	2.738	0.500	0.000
66.1	8	2	Radiolarian ooze	78.25	1.20	85.9	1.489	1791	34.600	0.008	2.764	0.000	2.764	0.500	0.000
66.1	8	3	Radiolarian ooze	79.75	1.18	87.4	1.483	1756	34.600	0.007	2.720	0.000	2.720	0.500	0.000
66.1	8	6	Radiolarian ooze	84.25	1.20	86.5	1478	1767	34.600	0.007	2.747	0.000	2.747	0.500	0.000

*NOTES: Depth = depth below sea floor, meters; ρ_B = saturated bulk density, gm/cm^3; ϕ = porosity, fraction of total volume; V_P = velocity, compressional wave, km/sec; Impedance = gm/cm^2 sec $\times 10^2$; K_G = weighted mean bulk modulus, dynes/cm^2 $\times 10^{10}$; K_S = skeletal bulk modulus, dynes/cm^2 $\times 10^{10}$; K = bulk modulus sediment, dynes/cm^2 $\times 10^{10}$; μ = rigidity, dynes/cm^2 $\times 10^{10}$; λ = Lame's constant, dynes/cm^2 $\times 10^{10}$; θ = Poisson's ratio; V_S = velocity of shear wave in km/sec.

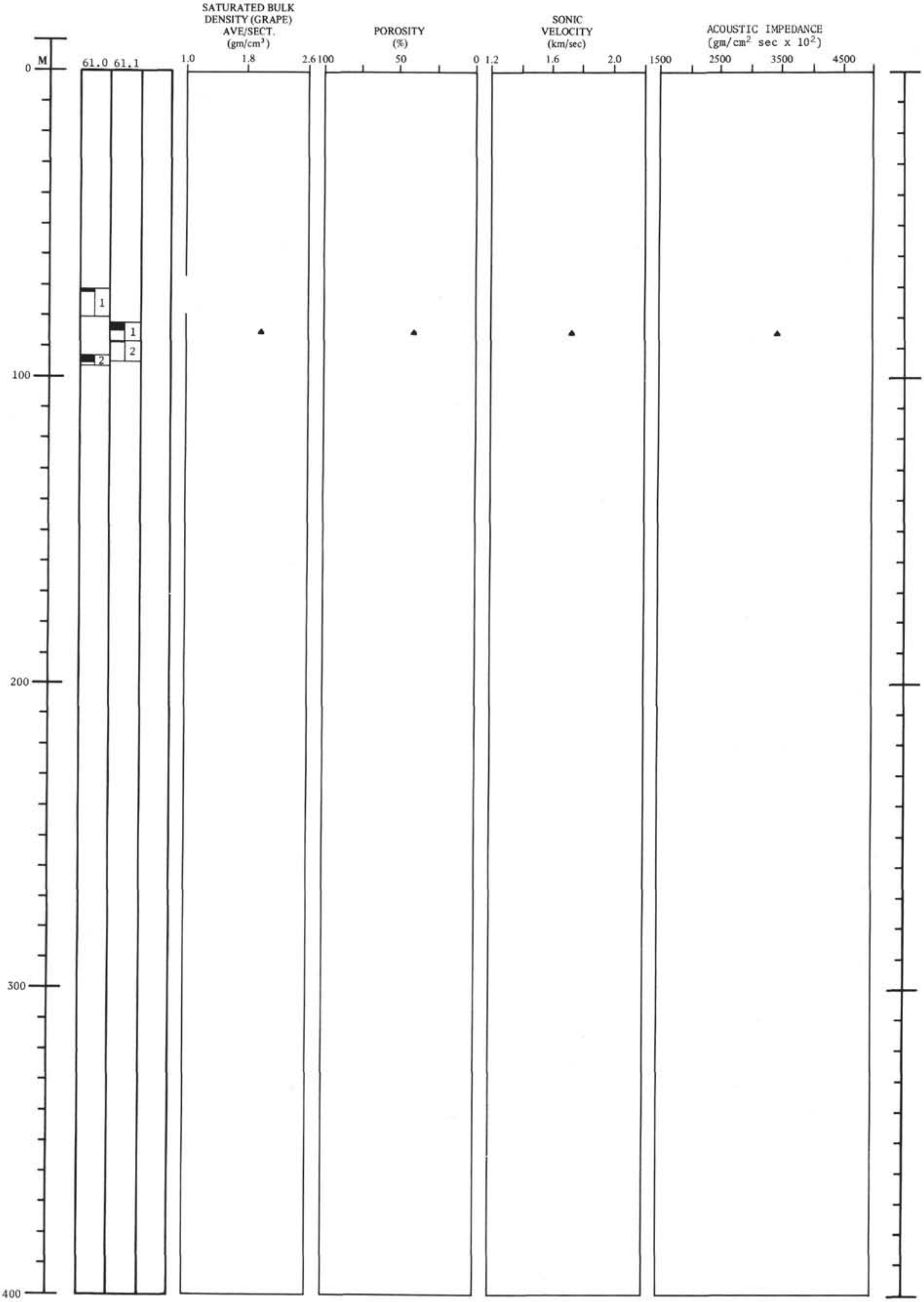

Figure 1. *Sound velocity, elastic constants, and related properties, Site 61.*

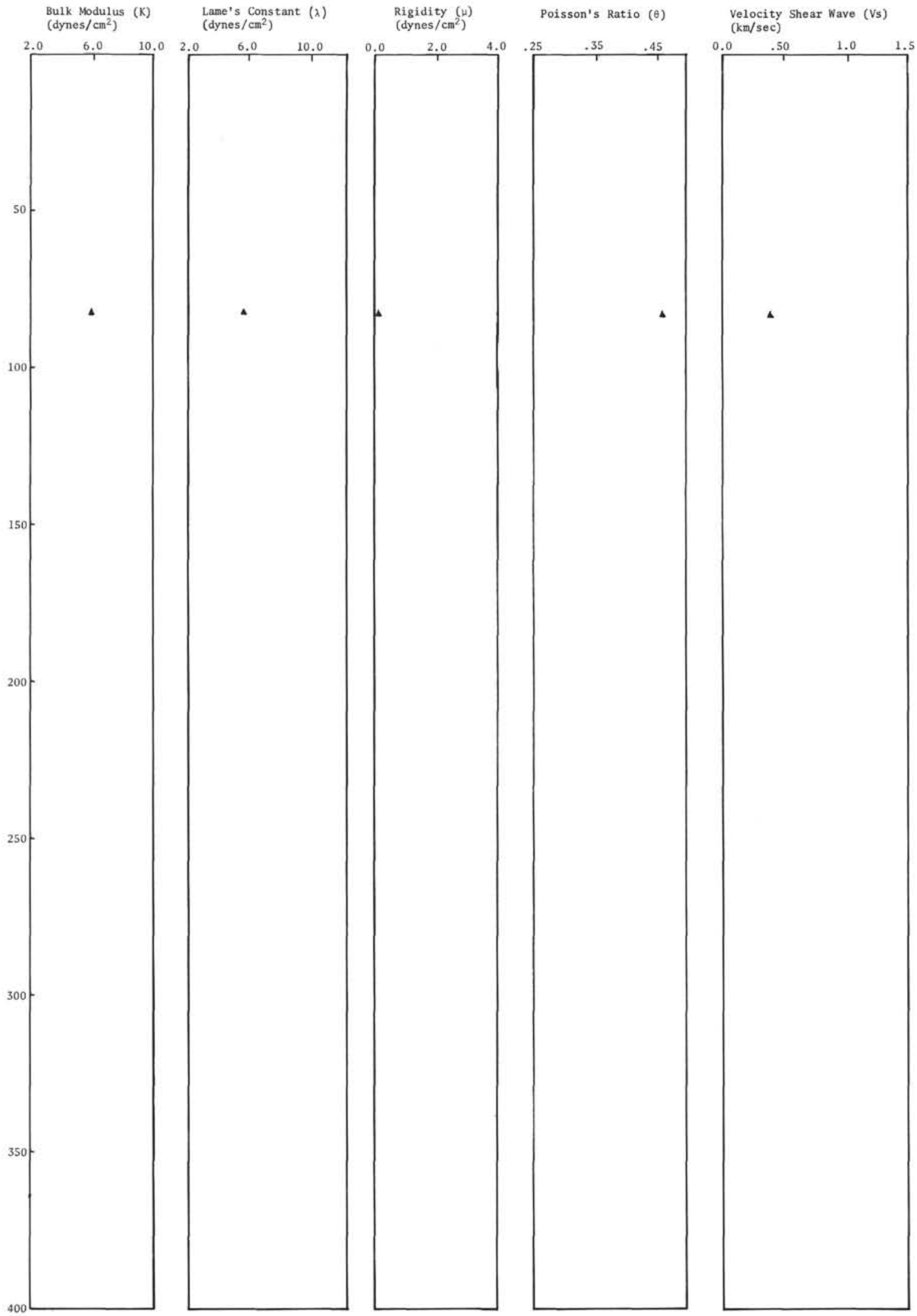

Figure 1. *Continued.*

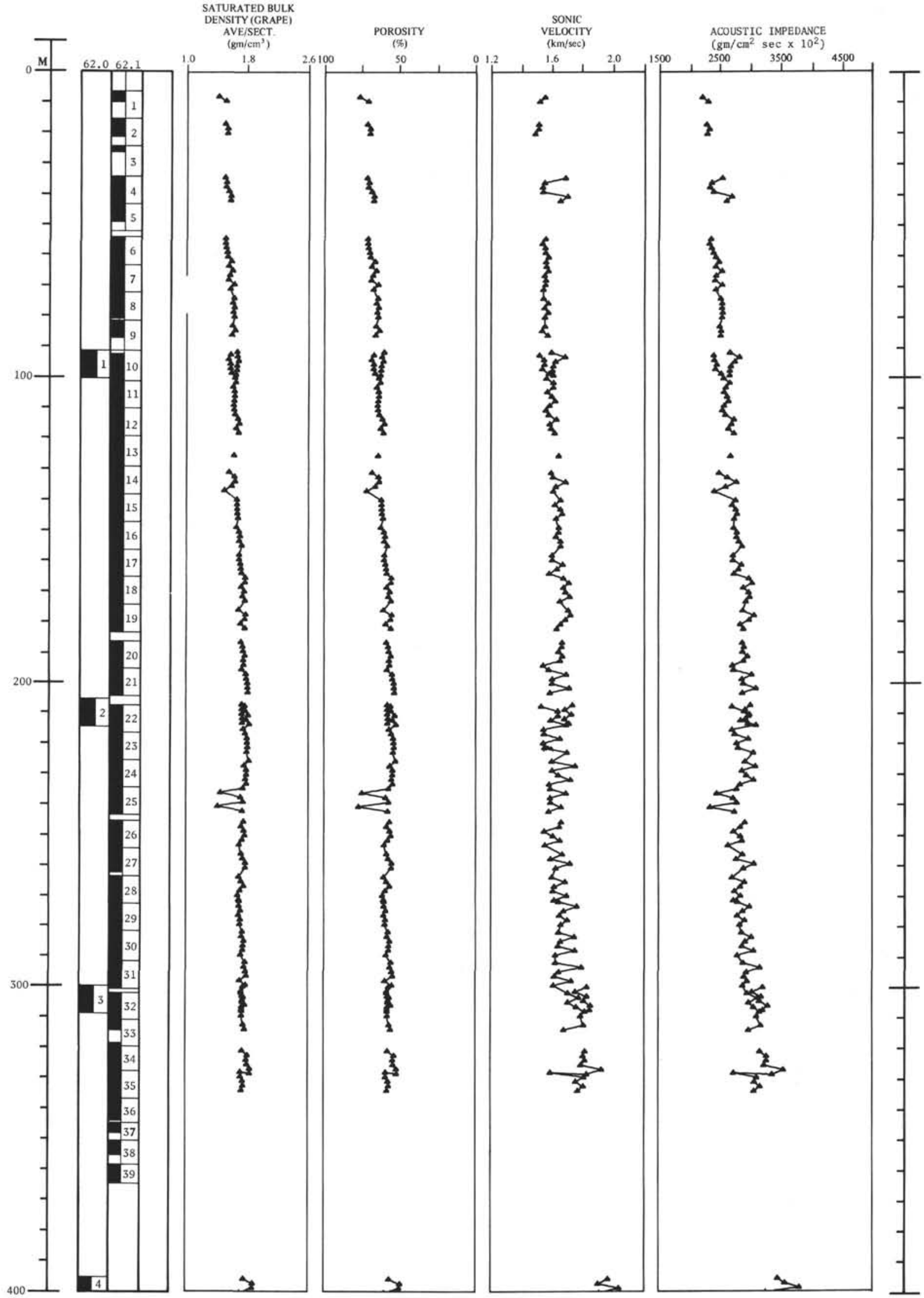

Figure 2. *Sound velocity, elastic constants, and related properties, Site 62, 0-400 m.*

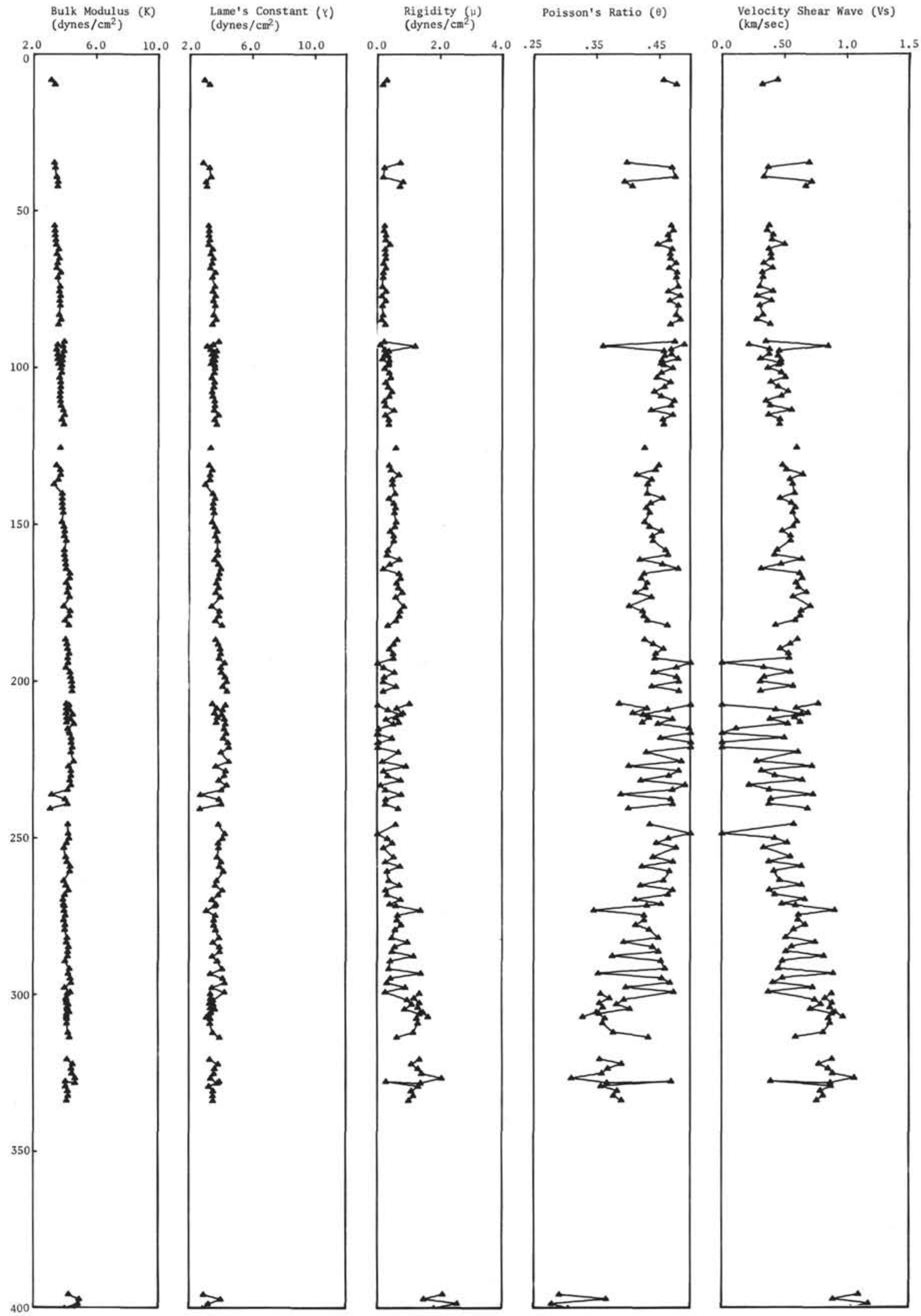

Figure 2. *(0-400 m) Continued.*

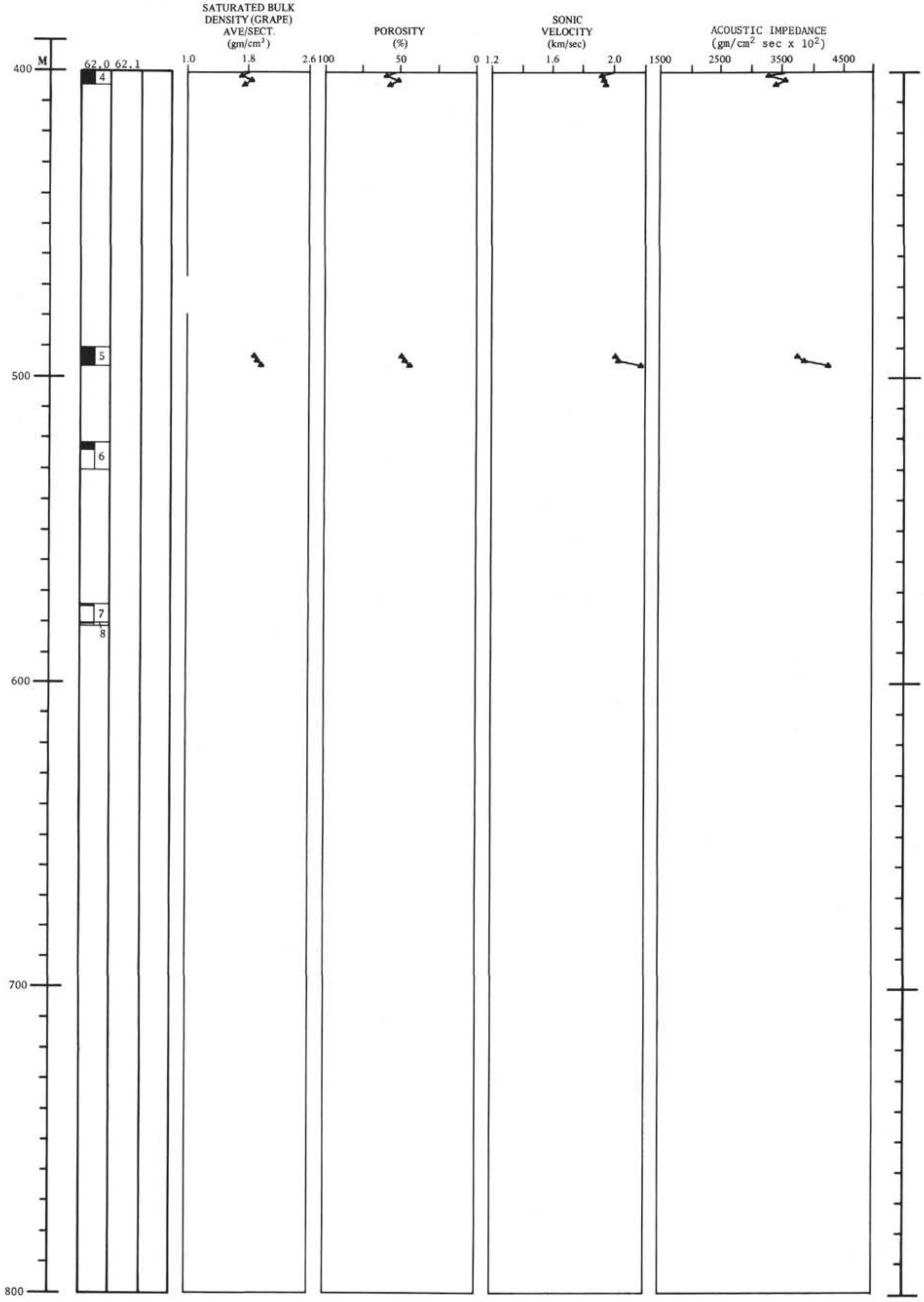

Figure 2. *Sound velocity, elastic constants, and related properties, Site 62, 400-800 m.*

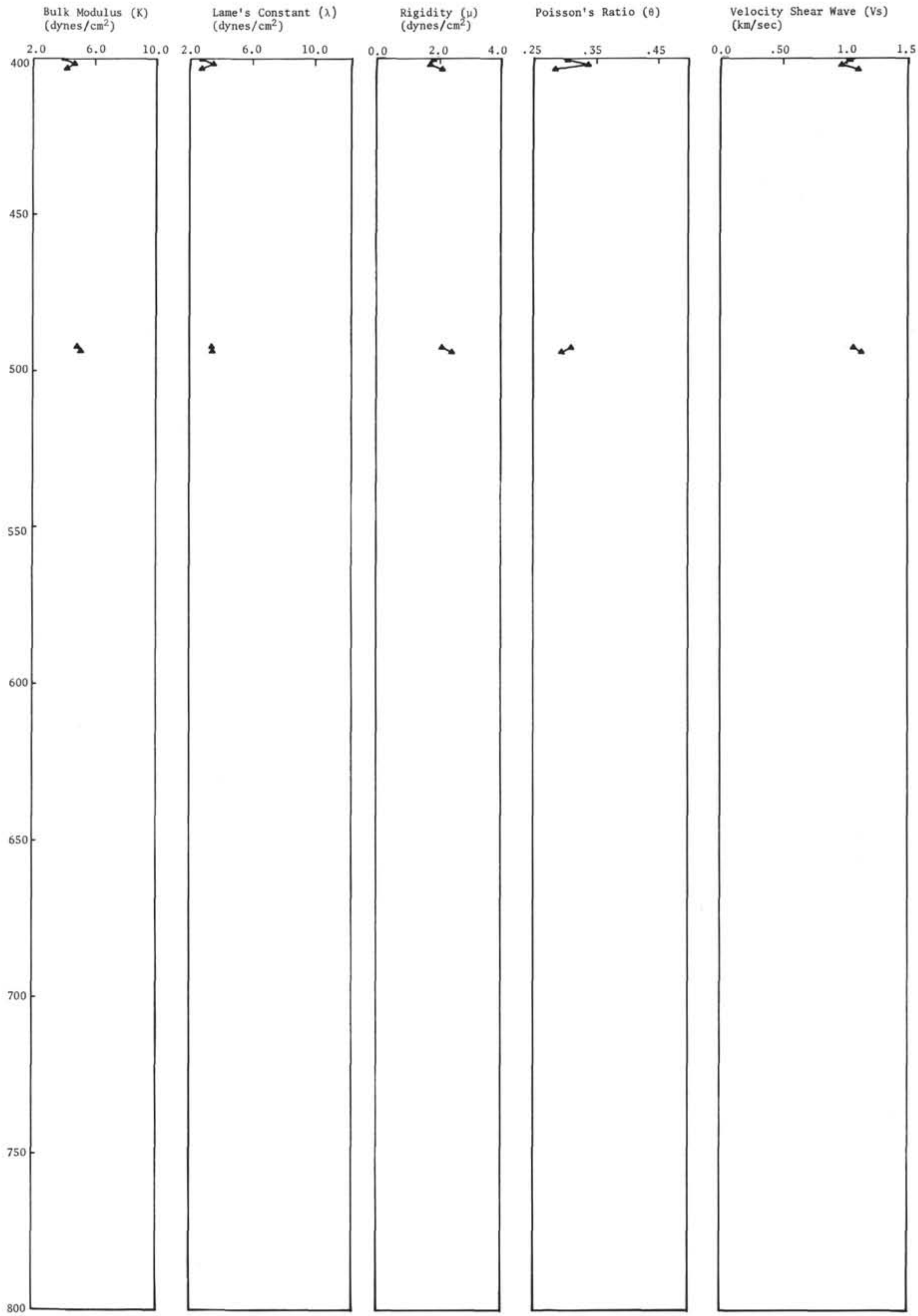

Figure 2. *(400-800 m). Continued.*

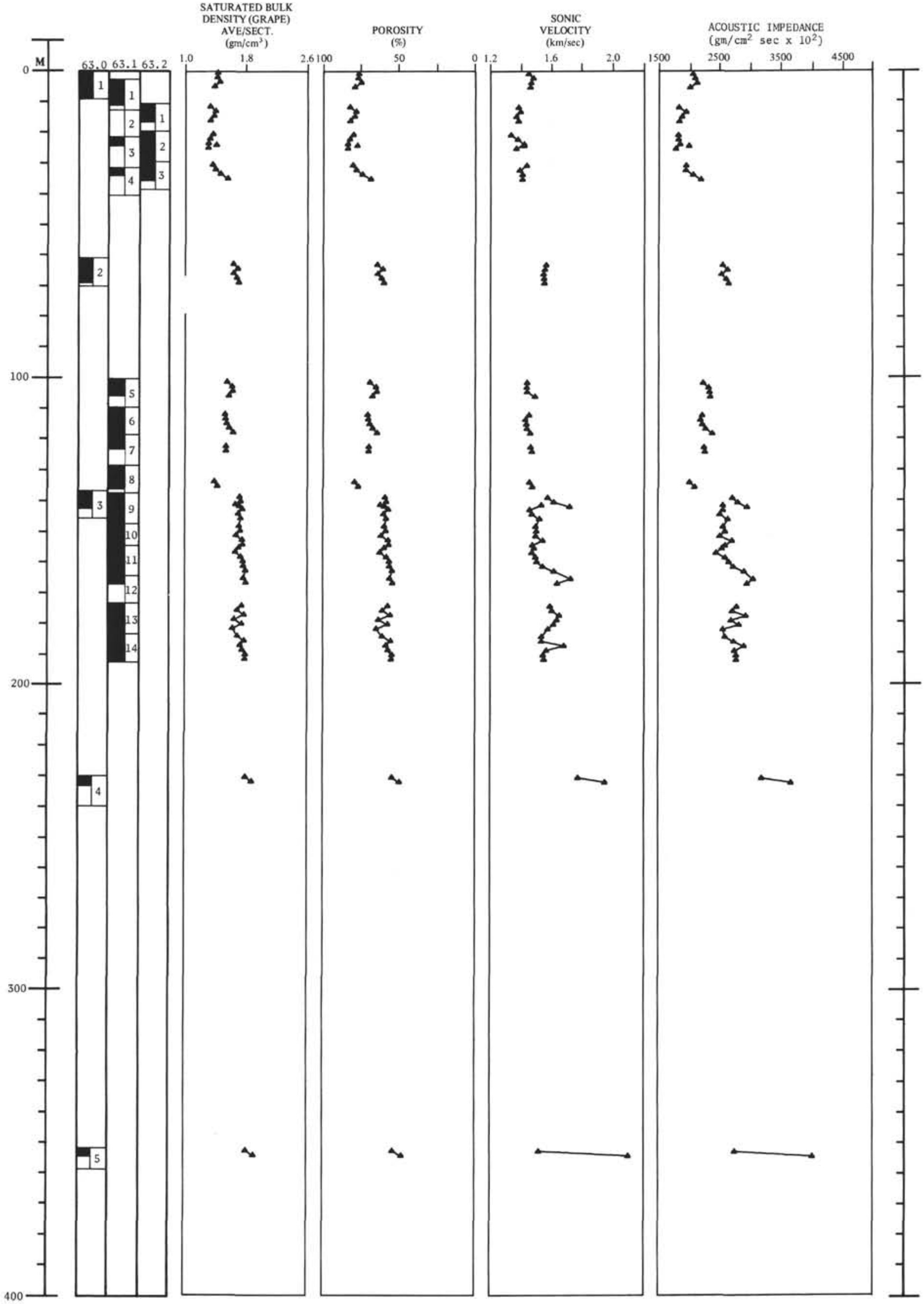

Figure 3. *Sound velocity, elastic constants, and related properties, Site 63, 0-400 m.*

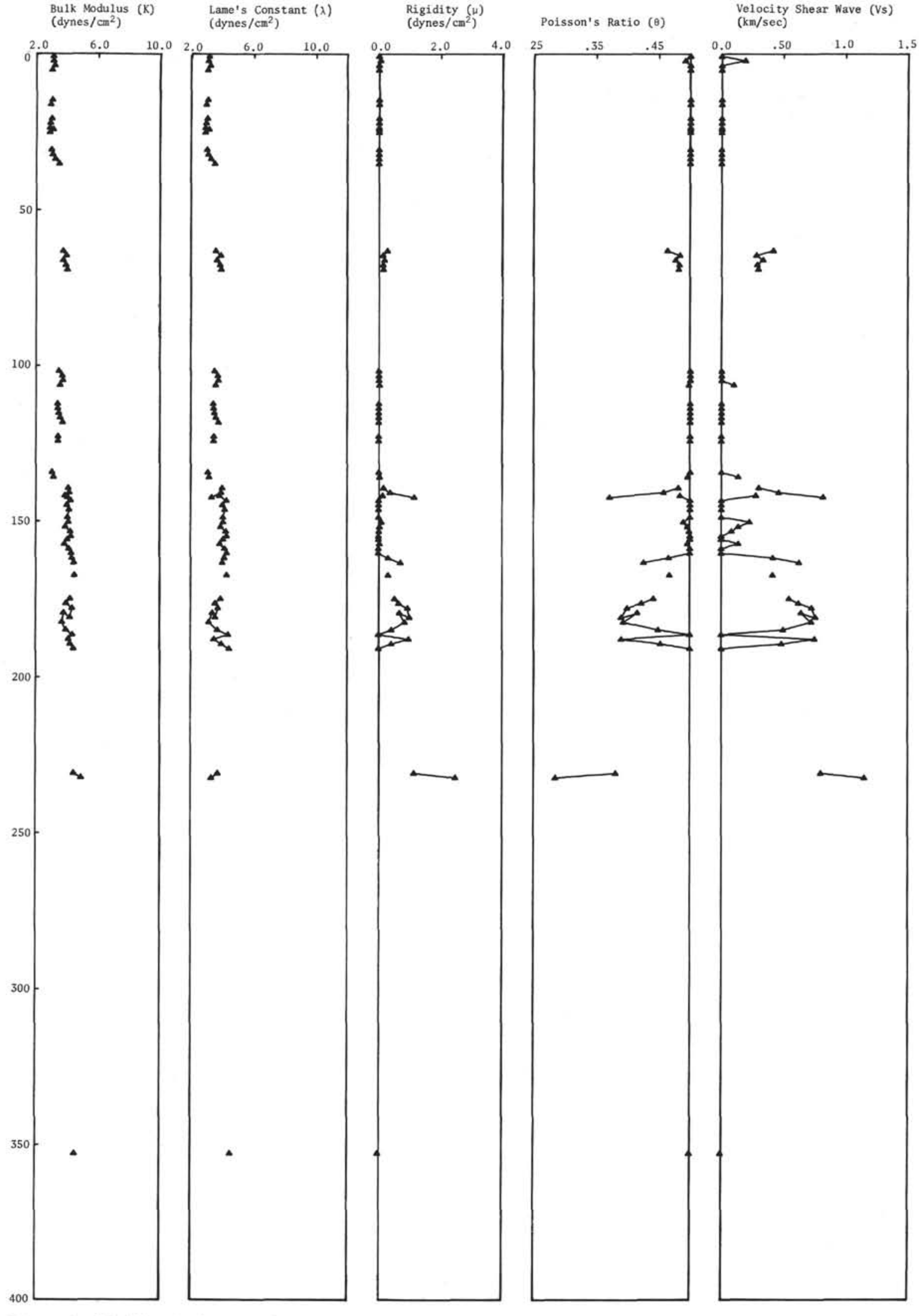

Figure 3. *(0-400 m) Continued.*

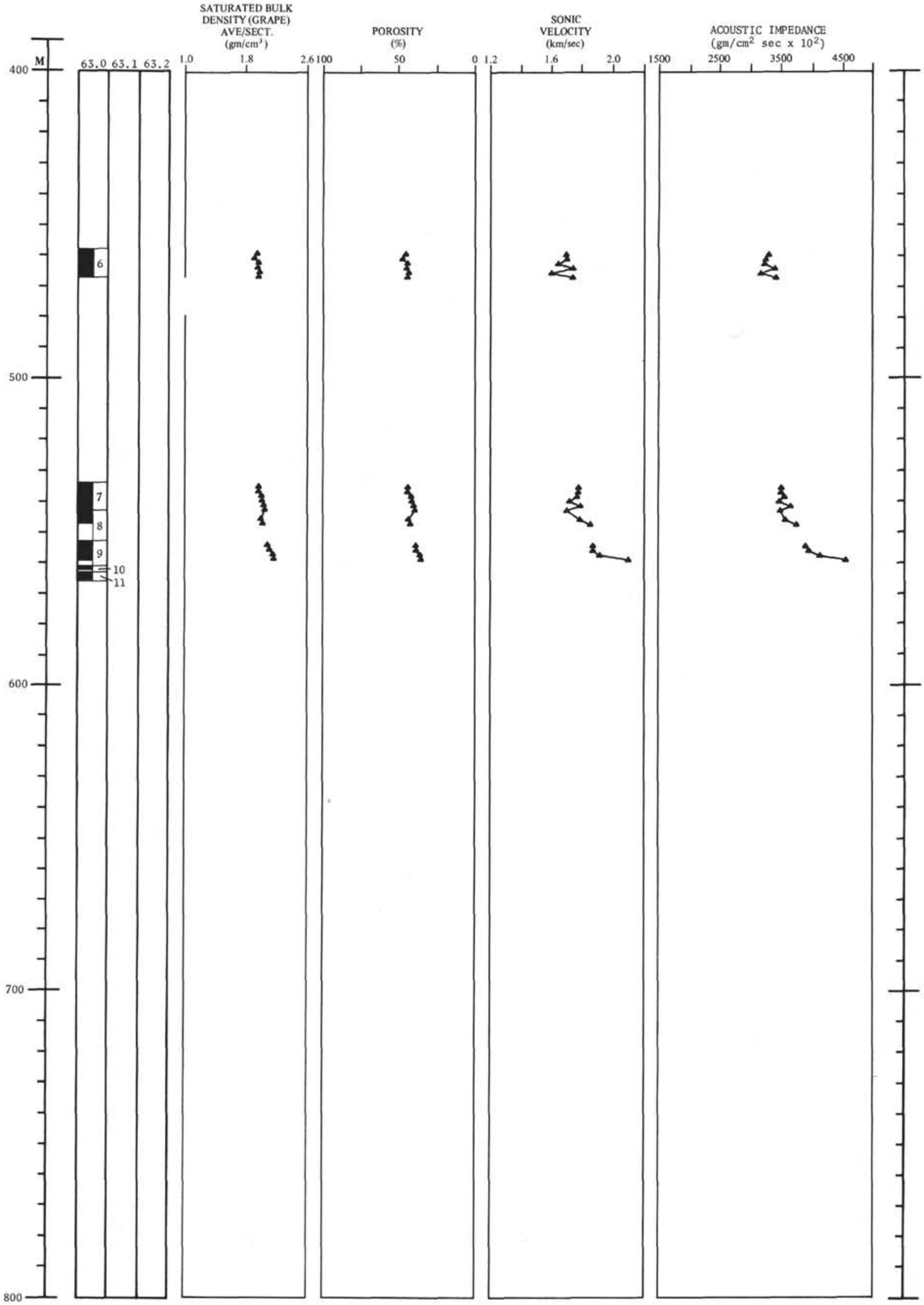

Figure 3. *Sound velocity, elastic constants, and related properties, Site 63, 400-800 m.*

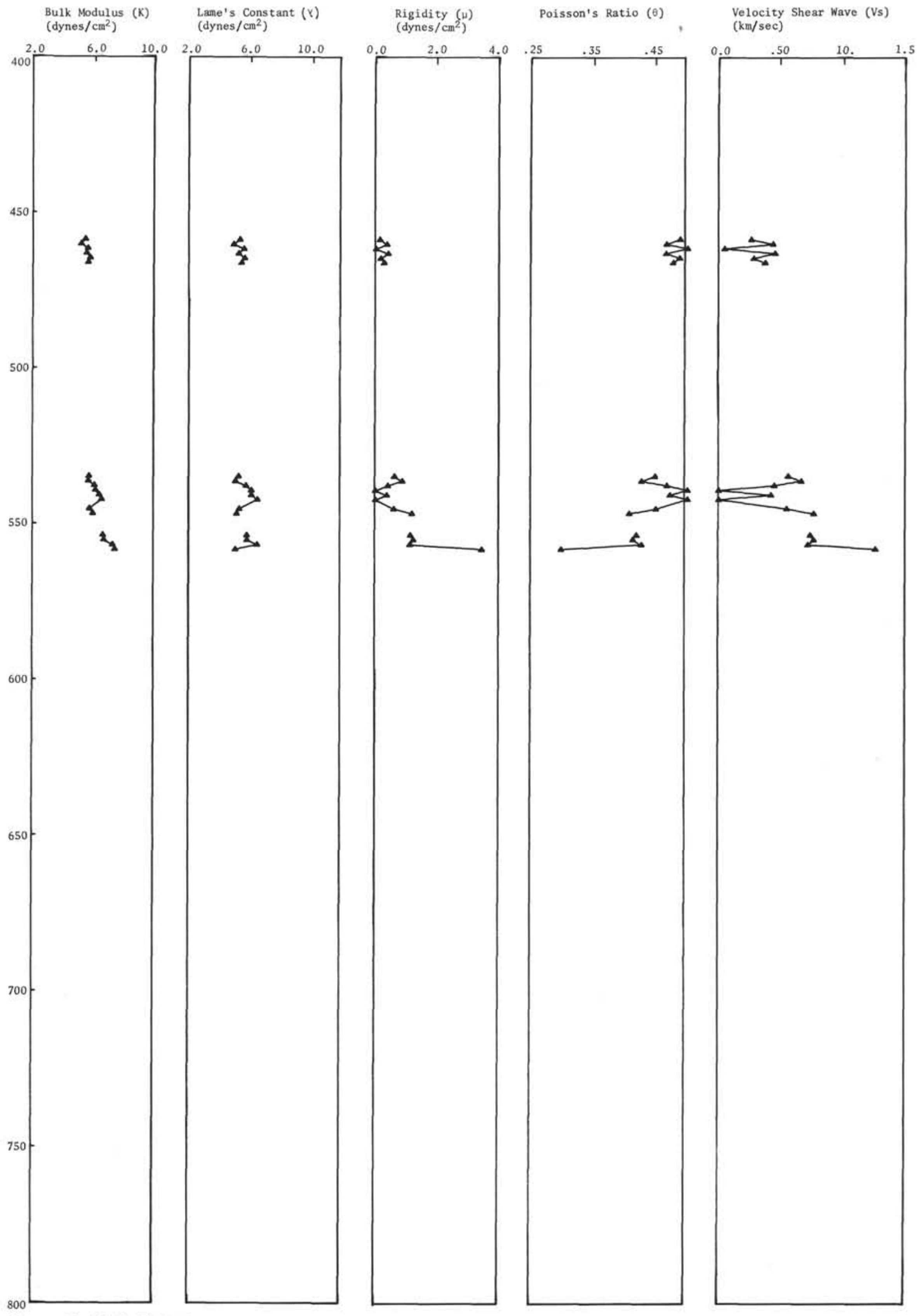

Figure 3. *(400-800) Continued.*

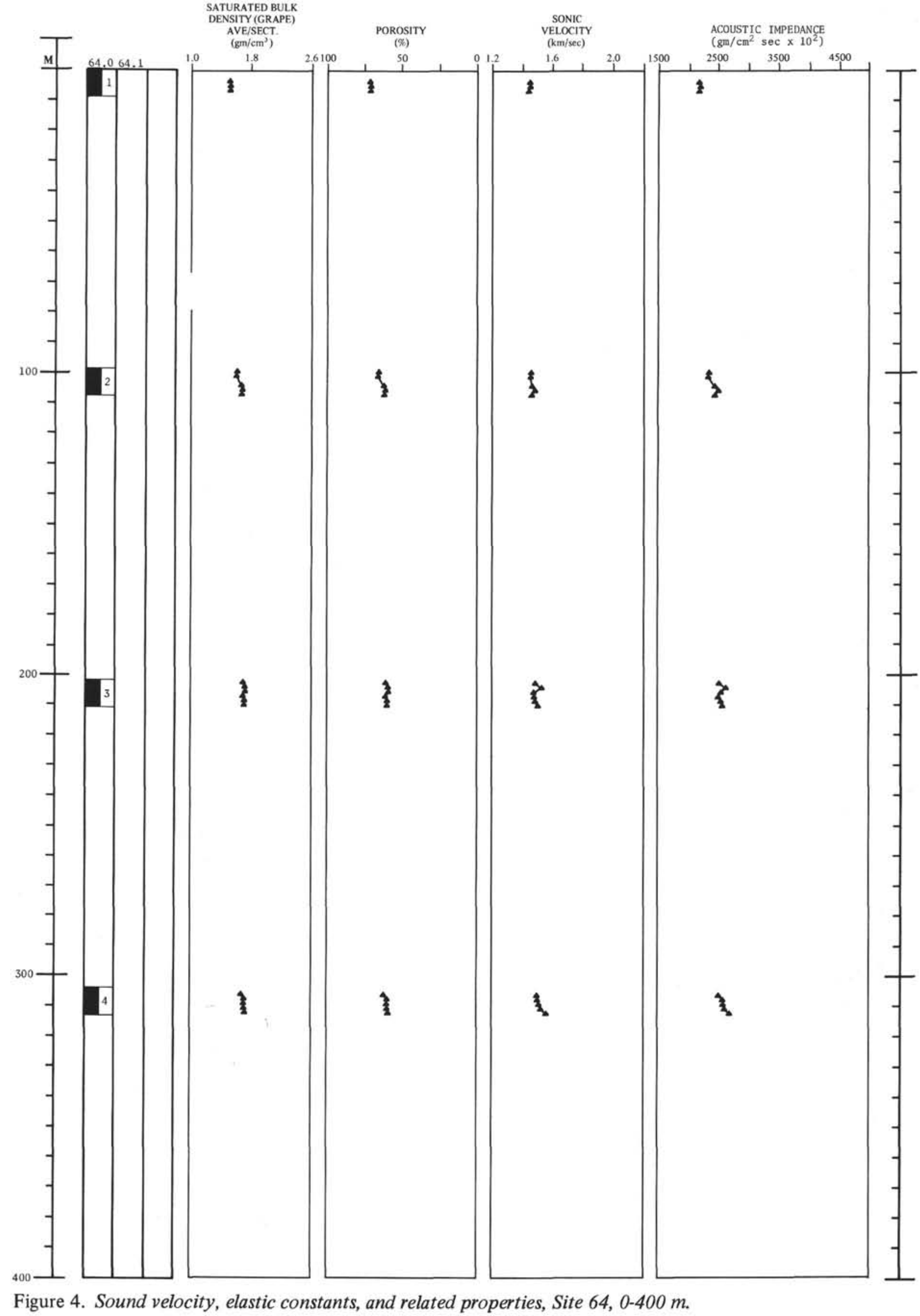

Figure 4. *Sound velocity, elastic constants, and related properties, Site 64, 0-400 m.*

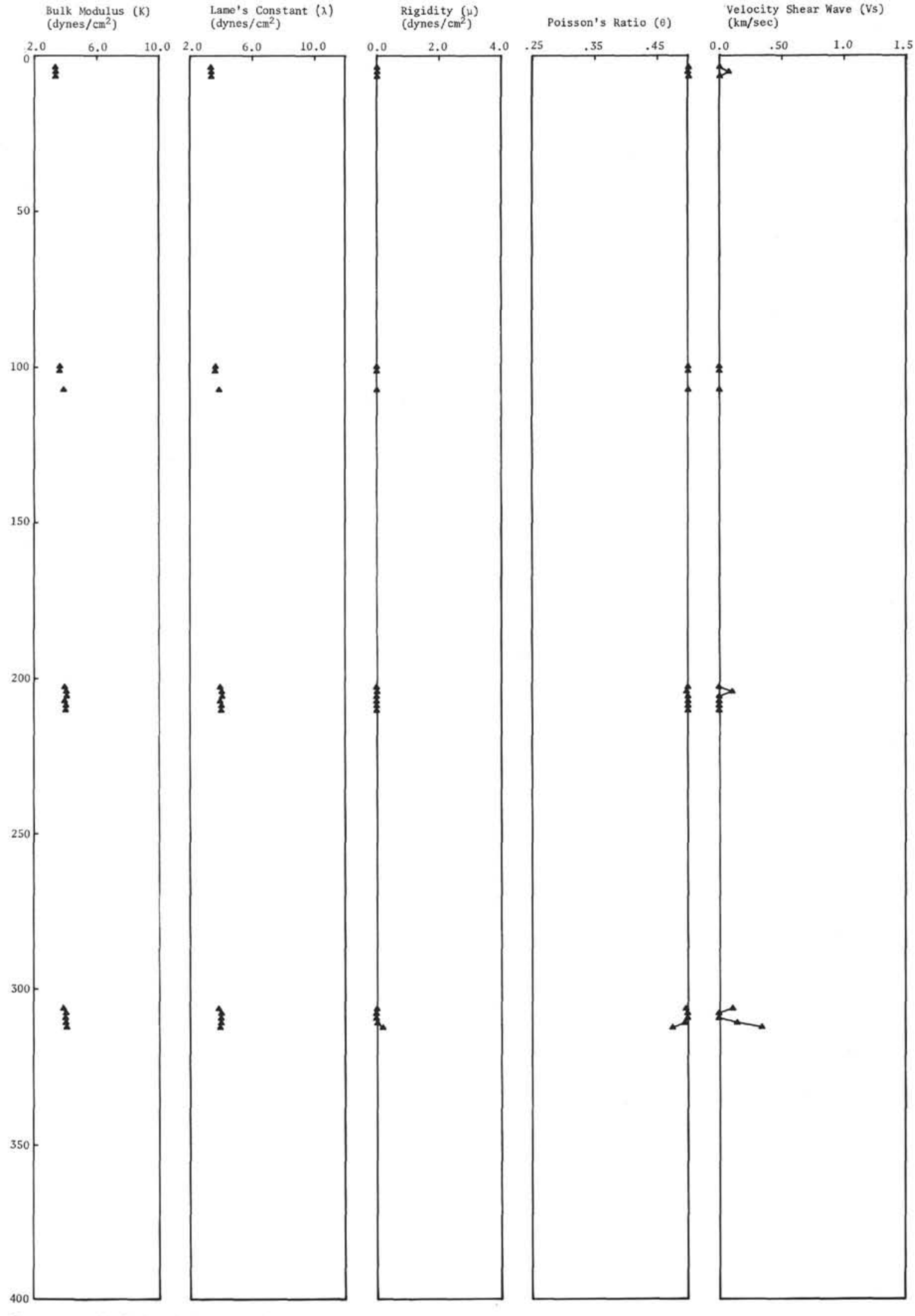

Figure 4. *(0-400 m) Continued.*

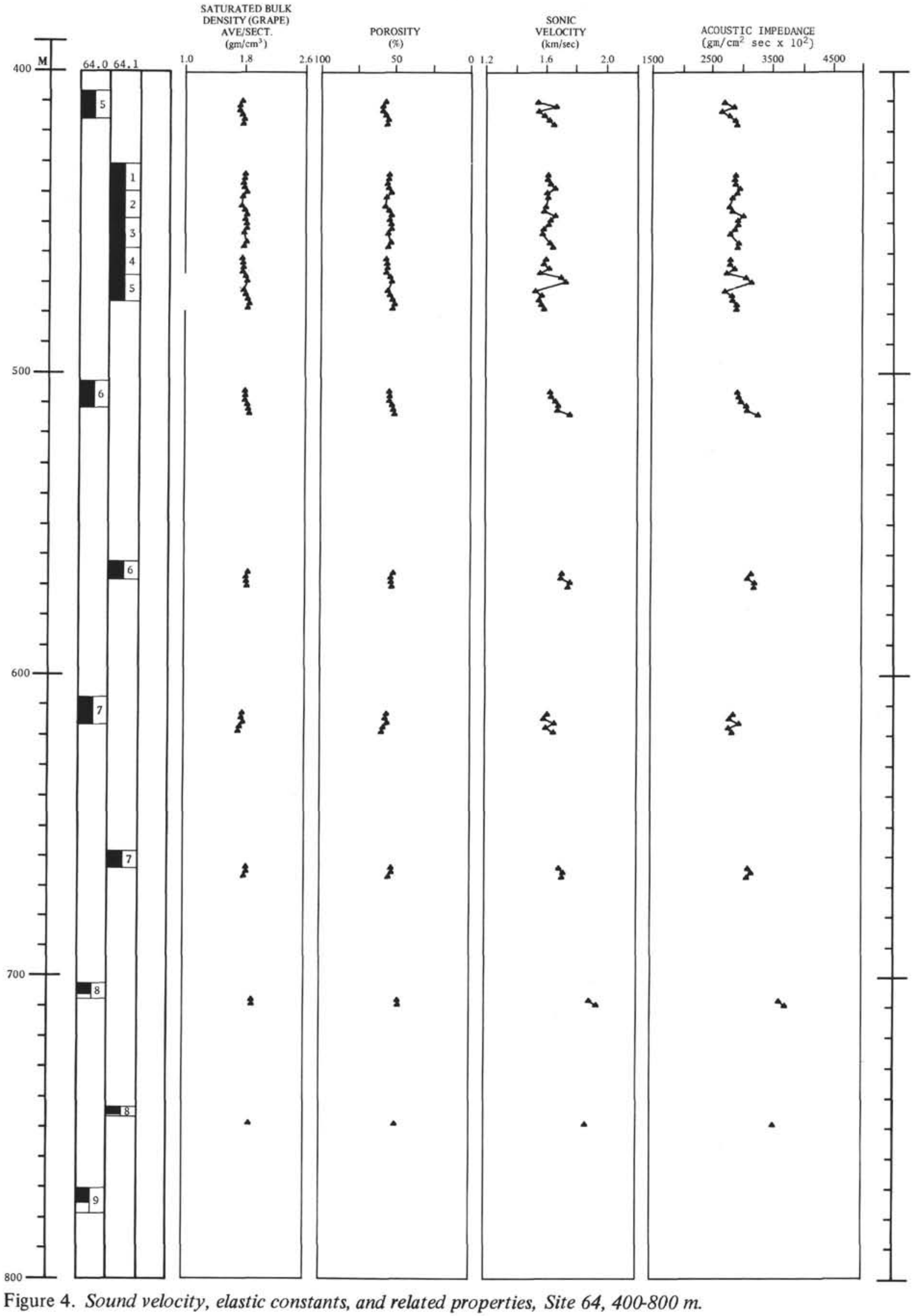

Figure 4. *Sound velocity, elastic constants, and related properties, Site 64, 400-800 m.*

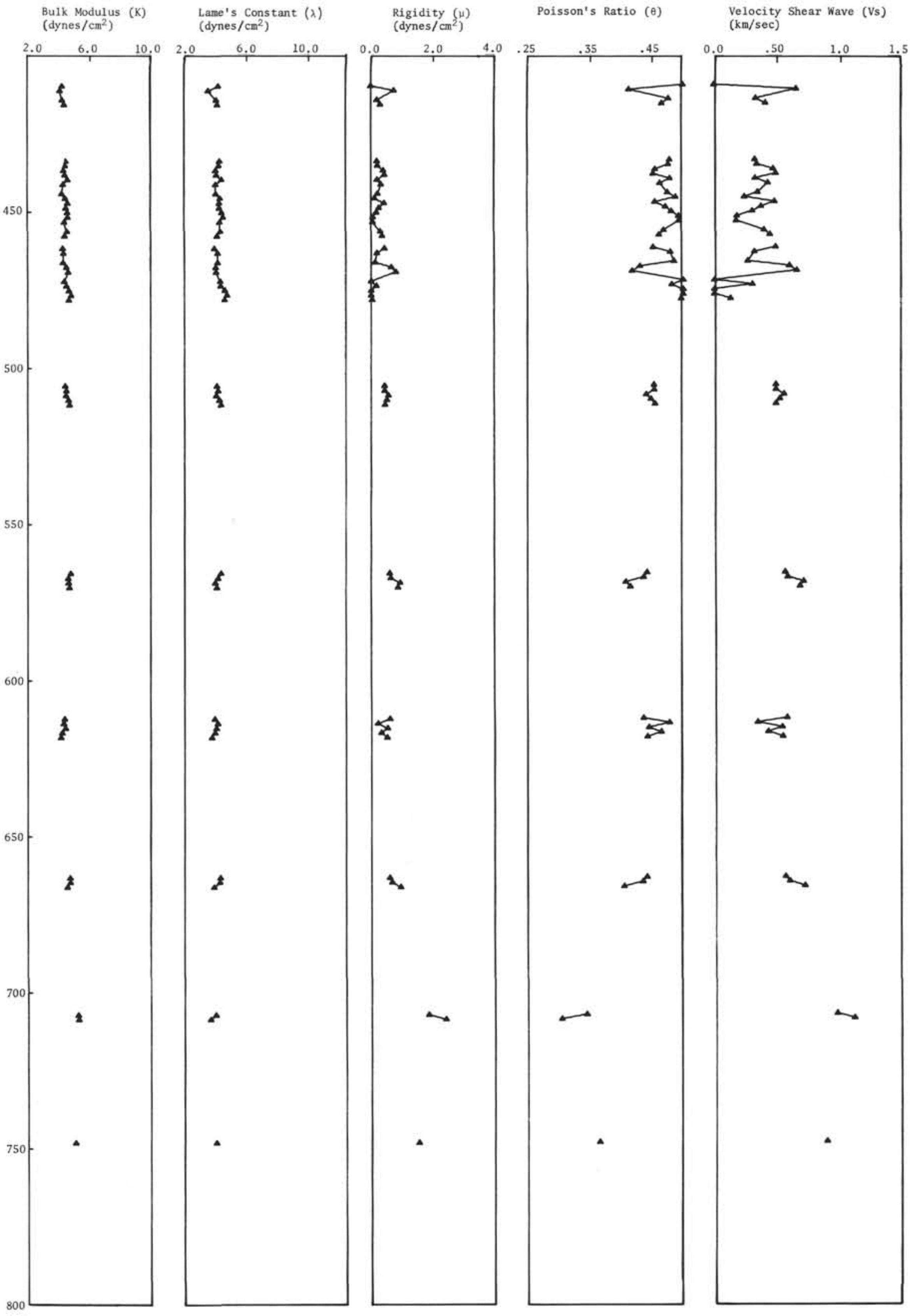

Figure 4. *(400-800 m) Continued.*

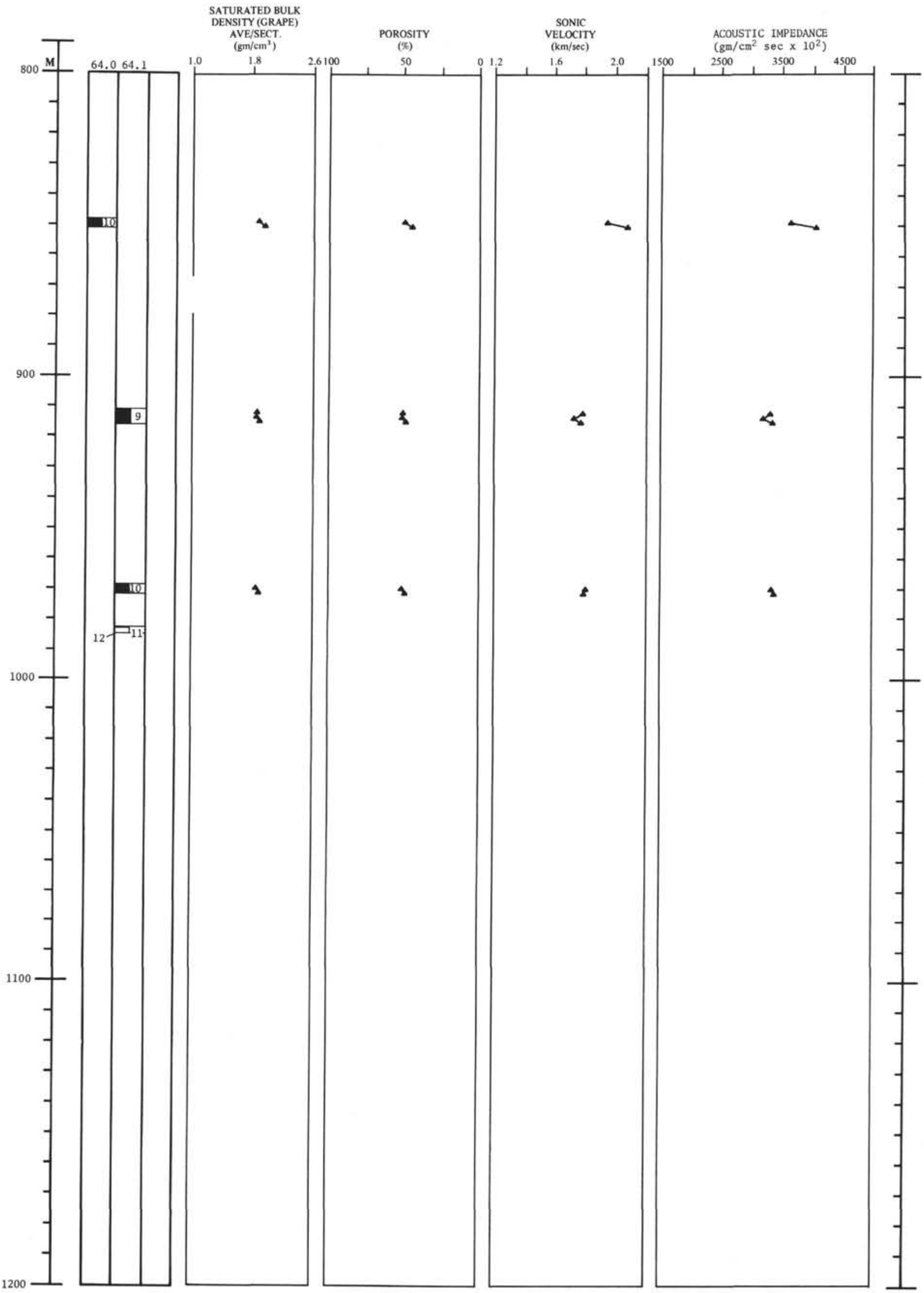

Figure 4. *Sound velocity, elastic constants, and related properties, Site 64, 800-1200 m.*

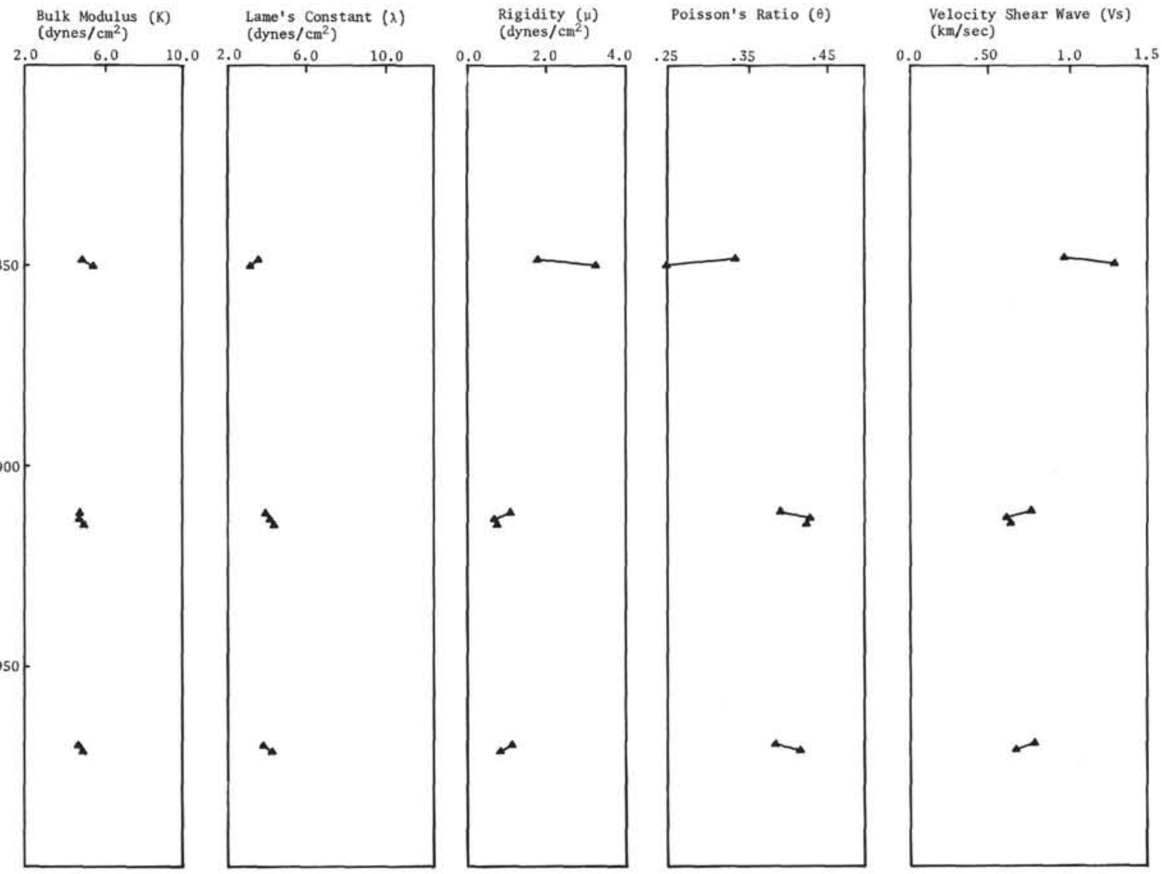

Figure 4. *(800-1200) Continued.*

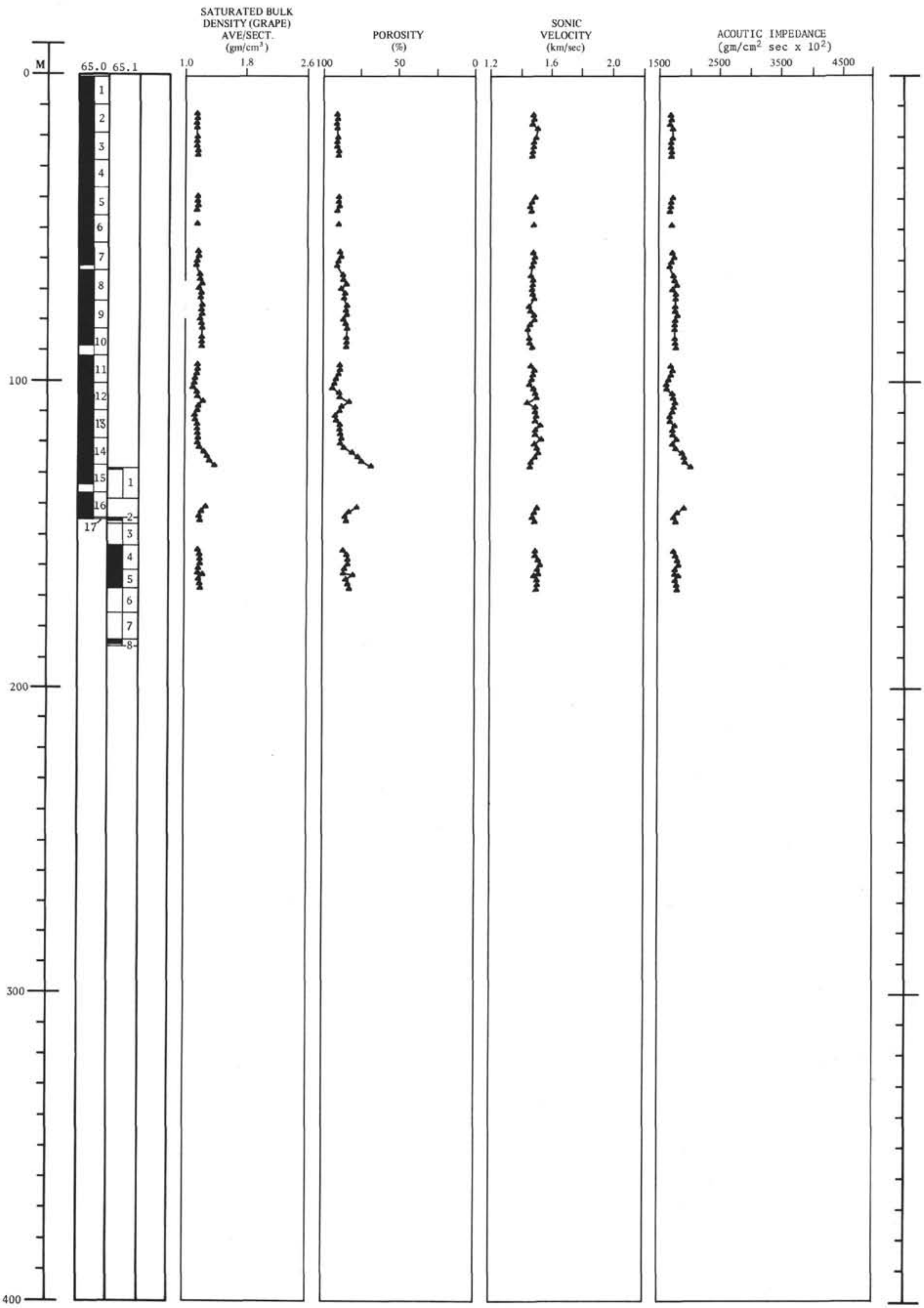

Figure 5. *Sound velocity, elastic constants, and related properties, Site 65.*

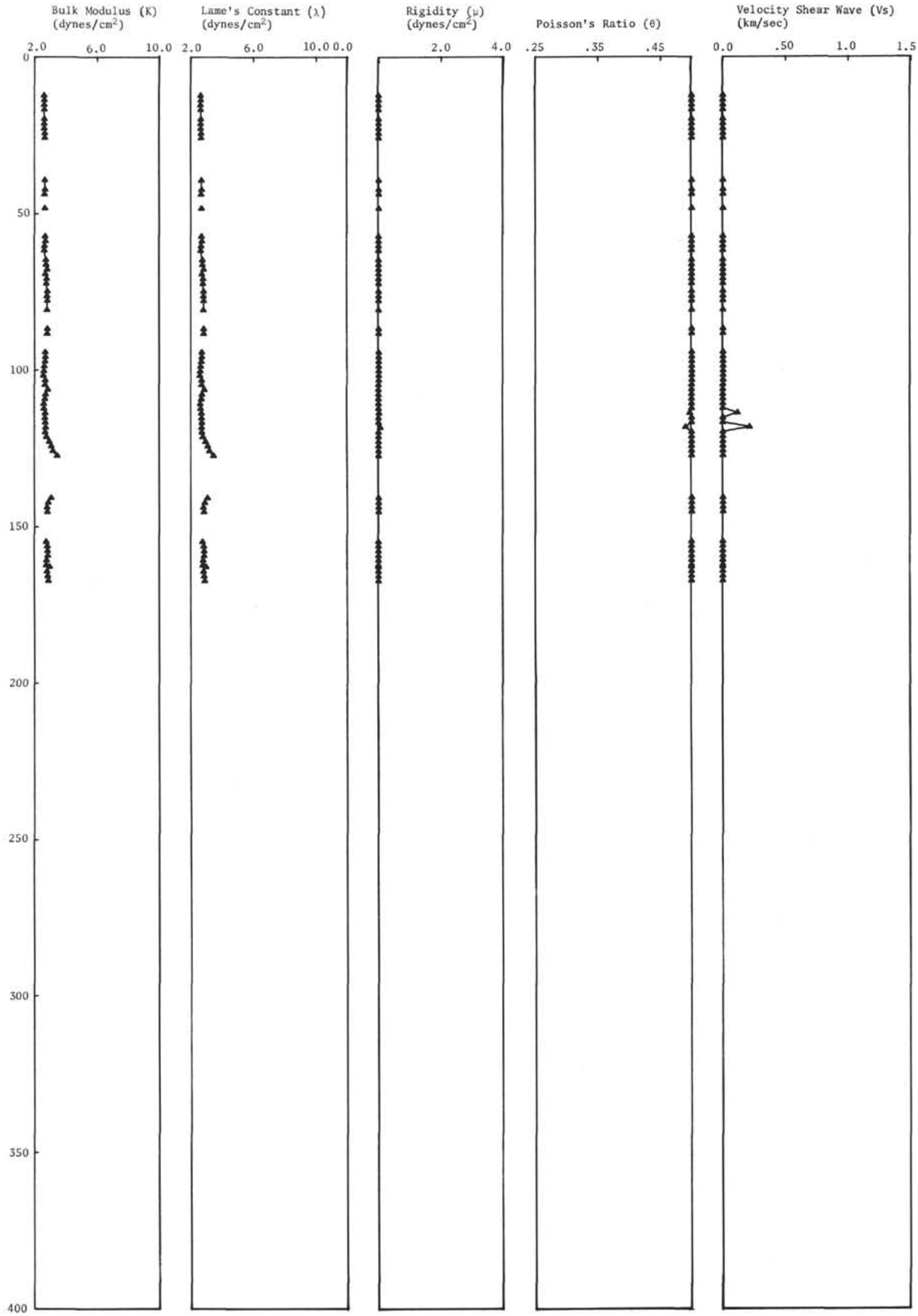

Figure 5. *Continued.*

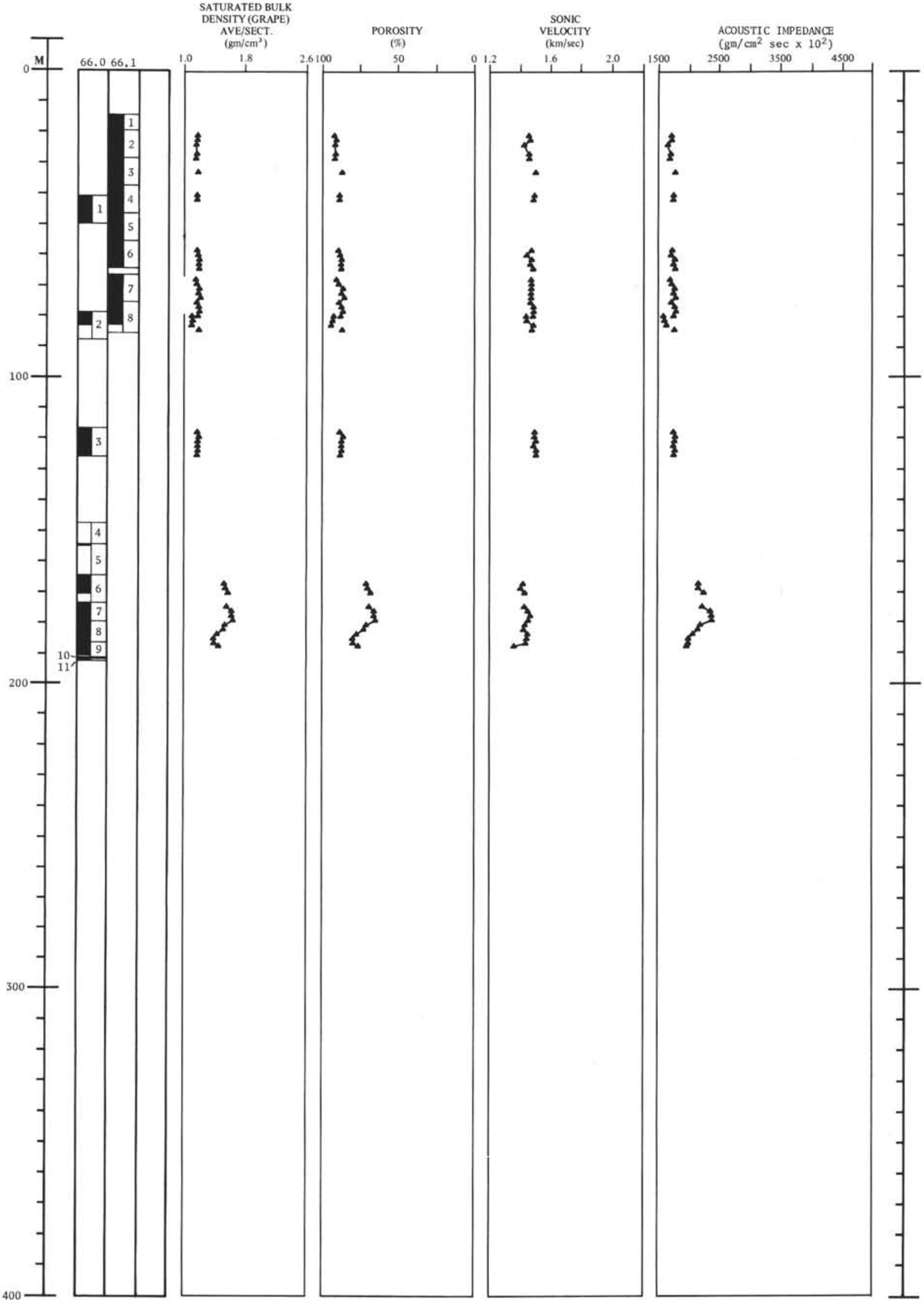

Figure 6. *Sound velocity, elastic constants, and related properties, Site 66.*

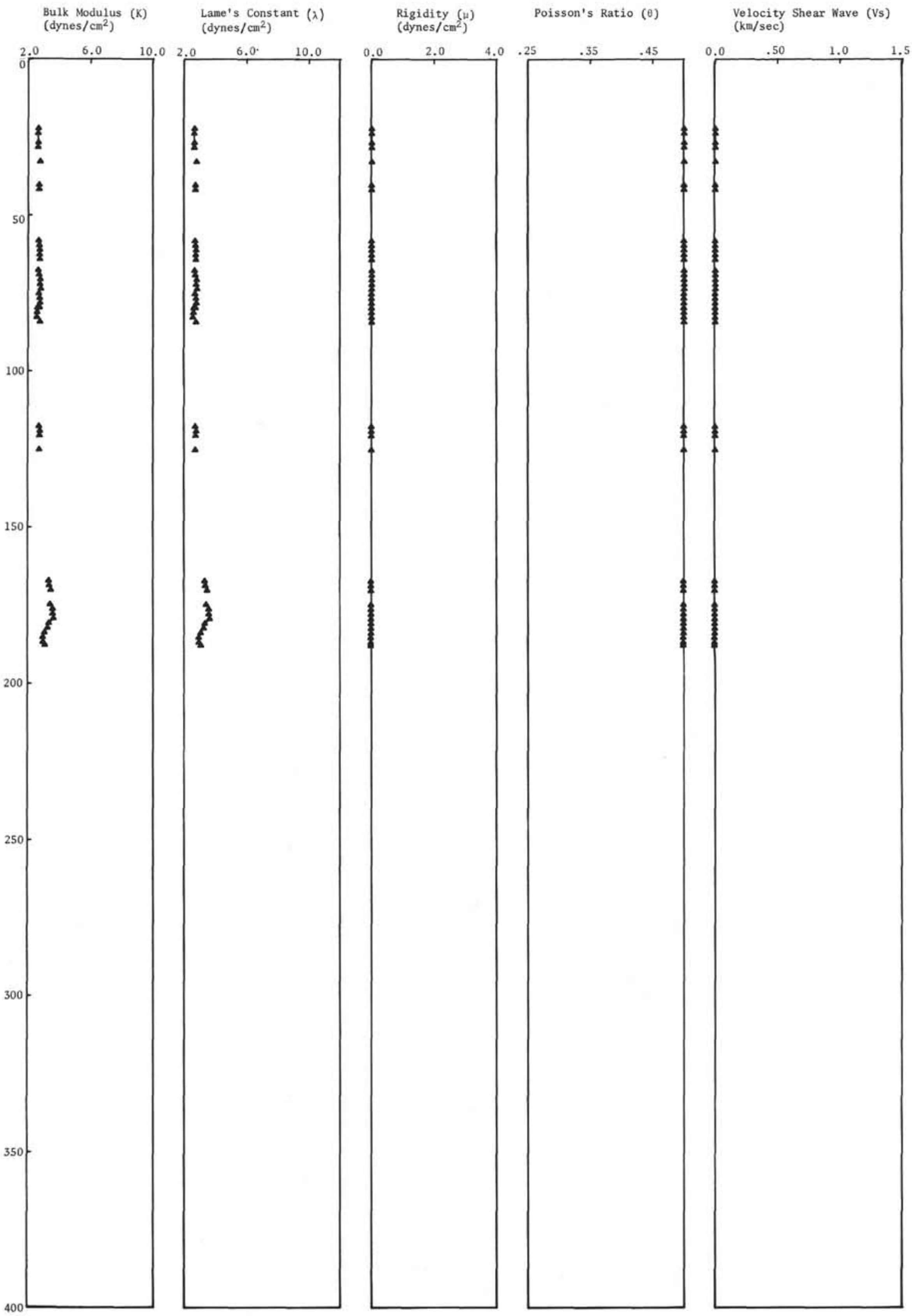

Figure 6. *Continued.*

change in shape or volume of the sediment. It is further assumed that such saturated sediments are elastic bodies, the behavior of which can be described by Hookean equations of elasticity. The validity of this approach is discussed by Hamilton (1971).

In Hamilton's (1971) analysis of Gassmann's (1951) work, the velocity of the compressional wave (V_p) in sediments is shown to be related to other elastic constants in the following manner:

Velocity compressional wave:

$$V_p \times 10^{-5} = \sqrt{\frac{K+\frac{4}{3}\mu}{\rho B}} \qquad (2)$$

where: V_p = velocity of compressional wave, in kilometers per second,

K = incompressibility of the total saturated sediment in dynes per square centimeter (the bulk modulus),

μ = rigidity modulus in dynes per square centimeter,

ρ_B = saturated bulk density in grams per cubic centimeter (above).

Acoustic Impedance

Acoustic Impedance (I) was calculated for all core sections from Sites 62, 63, 64, 65 and 66 where data were available:

$$I = V_p \cdot \rho_B (\text{gm/cm}^2\text{sec.} \times 10^2) \qquad (3)$$

These values are listed in Tables 2 through 6 and are shown plotted as a function of depth on Figures 2 through 6.

Bulk Modulus

The bulk modulus (K) of the total saturated sediment was derived for each section recovered from Sites 62, 63, 64, 65 and 66:

$$K = K_G \left(\frac{K_S + Q}{K_G + Q}\right) \text{ in dynes/cm}^2 \times 10^{10}$$

$$\text{[after Gassmann, (1951)]} \qquad (4)$$

where: K_G = weighted mean bulk modulus of the solid components, in dynes/cm^2 $\times$ 10^{10},

K_S = skeletal bulk modulus of Gassmann (or the frame bulk modulus of Hamilton), in dynes/cm^2 $\times$ 10^{10},

and $$Q = \frac{K_F(K_G - K_S)}{\phi(K_G - K_F)}, \qquad (5)$$

K_F = bulk modulus of the interstitial water, in dynes/cm^2 $\times$ 10^{10}.

The skeletal bulk modulus (K_S) can be derived provided that the velocities of both shear wave and compressional wave in the sediments are known. No measurements of shear wave velocities were made on retrieved cores on Leg 7. In the absence of such measurements, the following relationships were used:

For cores from Sites 65 and 66, which consist largely of radiolarian ooze and pelagic clay, a relationship derived by Hamilton (1971) for silt clay was used:

$$\log K_S = 3.73580 - 4.25075\phi,$$

$$\text{(where } K_S \text{ is in dynes/cm}^2 \times 10^8\text{).} \qquad (6)$$

For cores from Sites 62, 63 and 64, which consist largely of nannofossil chalk ooze, a relationship derived by E. L. Hamilton (personal communication) for calcareous material was used:

$$\log K_S = 3.86297 - 4.05522\phi,$$

$$\text{(where } K_S \text{ is in dynes/cm}^2 \times 10^8\text{).} \qquad (7)$$

The bulk modulus of the interstitial fluid (K_F) is assumed to be: (after NAVOCEANO S_p - 68, 1966)

$$K_F = 2.397082 \times 10^{10} \text{ dynes/cm}^2 \times 10^{10}. \quad (8)$$

The bulk modulus of the mineral grains (K_G) was approximated as follows:

For cores of radiolarian ooze from Sites 65 and 66, a value derived by E. L. Hamilton (personal communication) for the bulk modulus of opal [$K_{G(1)}$] was used:

$$K_{G(1)} = 34.6 \times 10^{10} \text{ dynes/cm}^2 \times 10^{10}. \quad (9)$$

For calcite, a value derived by Peselnick (1962) for the bulk modulus of [$K_{G(2)}$] is used:

$$K_{G(2)} = 72.90 \times 10^{10} \text{ dynes/cm}^2 \times 10^{10}. \quad (10)$$

For clay, a value used by Hamilton (1971) from (Skempton, 1961) for the bulk modulus of clay [$K_{G(3)}$] is:

$$K_{G(3)} = [50.0 \times 10^{10}] \text{ dynes/cm}^2 \times 10^{10}. \quad (11)$$

For cores from Sites 62, 63, and 64, a weighted value of grain bulk modulus $[K_{G(4)}]$ is used:

$$K_{G(4)} = [C \cdot K_{G(2)} + (1-C)\ K_{G(3)}]$$

$$\text{dynes/cm}^2 \times 10^{10} \qquad (12)$$

where: C = fraction of calcium carbonate in solid component of sediment by weight. Gealy (1971b).

For cores of pelagic clay from Site 66, $K_{G(3)}$ was used for the grain bulk modulus.

Values of K are listed in Tables 2 through 6 and are shown plotted as a function of depth on Figures 2 through 6. These values of K were then used with measured values of density and velocity to compute other elastic moduli.

Rigidity

The rigidity (μ) of the total saturated sediment was derived for each core section recovered from Sites 62, 63, 64, 65 and 66 where data were available.

$$\mu = \tfrac{3}{4}\ [\rho_B(V_p)^2 - K]\ \text{dynes/cm}^2 \times 10^{10}$$

$$\text{(after Hamilton, 1971).} \qquad (13)$$

Values of μ are listed in Tables 2 through 6 and are shown plotted as a function of depth on Figures 2 through 6.

Lame's Constant

Lame's constant (λ) of the total saturated sediment was derived for each core section recovered from Sites 62, 63, 64, 65 and 66 where data were available:

$$\lambda = [K - \frac{2}{3}\mu]\ \text{dynes/cm}^2 \times 10^{10}. \qquad (14)$$

Values derived are listed in Tables 2 through 6 and are shown plotted as a function of depth on Figures 2 through 6.

Poisson's Ratio

Poisson's ratio (σ) of the total saturated sediment was derived for each core section recovered from Sites 62, 63, 64, 65 and 66 where data were available:

$$\sigma = \frac{3K - \rho_B\,(V_p)^2}{3K + \rho_B\,(V_p)2} \qquad (15)$$

Values derived are listed in Tables 2 through 6 and are shown plotted as a function of depth on Figures 2 through 6.

Shear Wave Velocity

Shear wave velocity (V_s) of the total saturated sediment was derived for each core section recovered from Sites 62, 63, 64, 65 and 66 where data were available:

$$V_s = \left(\frac{\mu}{\rho_B}\right)^{1/2} \times 10^5, \text{ in km/sec.} \qquad (16)$$

Values derived are listed in Tables 2 through 6 and are shown plotted as a function of depth on Figures 2 through 6.

RESULTS

Site 61

Measurements of the velocity of the compressional wave were made with the shipboard velocimeter on only one section from Site 61 (61.1-1-2). The maximum measurement was 1.78 km/sec. Despite core disturbances, the sediment has some rigidity and a shear wave velocity of 0.35 km/sec is indicated.

Site 62

Holes at Site 62 penetrated about 500 meters of pure nannofossil chalk ooze. The section penetrated was cored almost continuously from 50 to 350 meters below the sea floor, and other cores above and below this interval give good coverage to a depth of about 500 meters. Measurements of the velocity of the compressional wave were made with the shipboard velocimeter on almost all sections.

The velocity of the compressional wave of one chalk sample from Site 62 was measured at the University of Hawaii. A sample from 62.1-36-5 from 130 to 134 centimeters has a velocity $[V_{p(max)}]$ of 2.018 km/sec when measured perpendicular to the bedding, and 2.109 km/sec when measured horizontal to the bedding. This compares with a velocity $[V_{p(max.)}]$ of 1.8 km/sec measured with the shipboard velocimeter in the overlying core, and of about 2.0 km/sec in Core 62.0-4 at 400 meters.

The maximum values of the velocity of the compressional wave in cores from Site 62, in general, increase exponentially with depth from a projected value of 1.5 km/sec near the surface to about 2.1 km/sec at 490 meters. Exceptions to this regular increase occur at two horizons: Several sections near 35 meters below the sea floor show velocities $[V_{p(max.)}]$ higher than the trend would indicate (1.7 km/sec versus 1.52); and, cores from the interval between 230 and 300 meters show velocities $[V_{p(max.)}]$ lower than expected by this trend. There is, in fact, a reversal: the maximum velocity

$[V_{p(max.)}]$ of sections from 225 meters is about 1.7 km/sec, whereas the maximum velocity $[V_{p(max.)}]$ of sections from 250 meters is only 1.6 km/sec. This decrease is paralleled by a slight decrease in saturated bulk density (from 1.79 to 1.72 gm/cm^3) and by a decrease in rigidity (from 4.5 to 4.0 dynes/cm^2).

The difference between velocity $[V_{p(max.)}]$ of successive core sections generally is small (±0.4 km/sec) to a depth of about 290 meters. Below this depth the variations are greater (±0.7 km/sec). It is at about this depth that lithificiation of the chalk increases markedly, and the scatter in rigidity values also increases. Some of these low values of velocity $[V_{p(max.)}]$ may reflect disturbances of the material by coring with attendant loss of rigidity. However, the semiconsolidated chalk sequence consists of alternating intervals of more and less indurated materials, and these natural variations may account for much of the scatter in the data. If the envelope of the values below 190 meters is considered, the maximum envelope probably represents values of undisturbed lithified sediment most closely; the minimum envelope the unconsolidated and/or disturbed equivalent.

The rigidity and the maximum envelope of derived values of shear wave velocity increase with depth. Also, the scatter in these data increases with depth. Even near surface sediments show some capacity to sustain shear stress. Sediments at 9 meters have a shear wave velocity of 0.3 to 0.4 km/sec. At 150 meters, the maximum shear wave velocity is about 0.55 km/sec; at 300 meters it is about 0.8 km/sec; and at 490 meters it is as high as 1.27 km/sec. Zero values of rigidity between about 200 and 250 meters probably reflect coring disturbances.

Ratios between the maximum compressional wave velocity and the maximum shear wave velocity as measured on cores $[V_{p(max.)}/V_s]$ decrease with depth. At 550 meters in nannofossil ooze, the ratio is 5.0. At 250 meters in partially lithified chalk ooze the ratio is 3.3. At 400 meters in lithified chalk the ratio is 1.9. At 495 meters in soft limestone the ratio is 1.8. Molotova and Vassil'ev (1960) give data which indicate that these ratios range from about 1.8 to 3.5 in chalks and from about 1.5 to 1.95 in limestones; Press (1966) shows that saturated clays have ratios which range from 2.08 to 13.7. Thus, it appears likely that derived values of shear wave velocity at Site 62 are valid, provided that maximum values are used. Very low values without doubt reflect core disturbance and dilution.

Site 63

Holes at Site 63 penetrated more than 560 meters of section consisting of 35 meters of marl and clay overlying a very pure nannofossil chalk-ooze. Continuous coring was attempted at Site 63 from the sea floor to a depth of 195 meters. Below 195 meters, cores were taken only about each 100 meters. Measurements of the velocity of the compressional wave were made on almost all core sections with the shipboard velocimeter. The compressional wave velocity of seven indurated samples from Site 63 were measured with the University of Hawaii velocimeter. Results are shown in Table 7.

Visual inspection of cores recovered at this site show that lithification increases with depth and that parts or all of the many cores were badly disturbed by the coring process. Maximum values of shear velocity at 180 meters, 225 meters and at 550 meters confirm an increase in rigidity with depth comparable to that at Site 62. However, most core sections have no rigidity and no shear wave velocity, and this lack is almost certainly due to destruction of rigidity by the coring process. This disturbance also makes compressional wave velocity measurements questionable. Thus, only the maximum values in any given interval should be considered indicative of *in-situ* values. Based only on these selected values which are indicative of *in-situ* conditions, the elastic properties of sediments at Site 63 can be summarized as follows.

Generally, the velocity $[V_{p(max.)}]$ increases exponentially with depth. However, the rate of increase drops between 180 and 350 meters, then increases again to the total depth. The velocity $[V_{p(max.)}]$ in the near-surface clay is about 1.45 km/sec and in the underlying nannofossil ooze at 65 meters about 1.57 km/sec. At 165 meters $V_{p(max.)}$ is as high as 1.77 km/sec (sample), but a value of 1.6 to 1.7 km/sec may be more representative of the whole rock. At 350 meters, one measurement is as high as 2.41 km/sec, but a value of 1.9 km/sec may be more representative. At 560 meters, one measurement as high as 2.44 km/sec was made on the shipboard velocimeter. The velocity of a sample from this interval measured at the University of Hawaii is 2.5 km/sec. The limestone at this depth is well indurated and velocities $[V_{p(max.)}]$ in the range 2.4 to 2.5 are probably indicative of *in-situ* values.

Because of the disturbance of the cores at Site 63, no shear wave velocity could be determined. A few derived values, however, may be indicative of *in-situ* conditions:

A core section at a depth of 2 meters shows a rigidity of 0.03 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of 0.14 km/sec. A section at 63 meters shows a rigidity of 0.20 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of 0.35 km/sec. Several sections near 180 meters show a rigidity of about 0.85 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of about 0.7 km/sec. One section at 232

TABLE 7
Measurements of Velocity of Compressional Wave, University of Hawaii, for Samples from Site 63

Hole	Core	Section	Interval (cm)	Lithology	Compressional Wave Velocity km/sec	Note
63.0	8	1	113-119	Pink chalk	2.114	Perpendicular to bedding
63.0	8	1	113-119	Pink chalk	2.402	Parallel to bedding
63.0	9	1	136-142	Nannofossil marl	2.223	Perpendicular to bedding
63.0	9	1	136-142	Nannofossil marl	2.290	Parallel to bedding
63.0	9	3	116-123	Nannofossil marl	2.326	Perpendicular to bedding
63.0	9	3	116-123	Nannofossil marl	2.499	Parallel to bedding
63.1	10	3	17-21	Nannofossil chalk	1.766	Perpendicular to bedding
63.1	10	3	17-21	Nannofossil chalk	1.630	Parallel to bedding
63.1	11	2	107-111	Nannofossil chalk	1.704	Perpendicular to bedding
63.1	11	2	107-111	Nannofossil chalk	1.623	Parallel to bedding
63.1	12	2	45-50	Soft nannofossil chalk	1.680	Perpendicular to bedding
63.1	12	2	45-50	Soft nannofossil chalk	1.658	Parallel to bedding
63.1	13	6	78-82	Soft nannofossil chalk	1.702	Perpendicular to bedding
63.1	13	6	78-82	Soft nannofossil chalk	1.728	Parallel to bedding

meters showed a rigidity as high as 2.19 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of 1.08 km/sec, but a rigidity value of about 1 dyne/cm^2 $\times$ 10^{10} and a shear wave velocity of about 0.76 km/sec may be more characteristic of the total rock. At 560 meters, one section showed a rigidity of 3.2 dynes/cm^2 $\times$ 10^{10} and a sonic velocity of 1.25 km/sec.

These values indicate that the shear wave velocity increases with depth and that the rate of increase decreases with depth.

Valid sonic velocity data collected at this site are too sparse to permit detection of changes in impedance which might account for reflectors noted on seismic profiles.

Site 64

Holes at Site 64 penetrated almost 1 kilometer of very pure nannofossil chalk ooze. Except for the interval between 430 and 480 meters, Site 64 was cored only at intervals of 50 meters or greater. Compressional wave velocity measurements were made on almost all sections recovered.

The sonic velocity of twelve samples from Site 64 were measured with the University of Hawaii velocimeter. Results are shown on Table 8.

Cores recovered in the upper 200 meters, with few exceptions, show compressional velocities less than 1.5 km/sec. Cores from the upper nine meters show a velocity of about 1.45 km/sec. Cores below 200 meters show an irregular exponential increase in compressional wave velocity with depth. Examples of maximum values are: 1.72 km/sec at 510 meters, 2.09 km/sec at 710 meters, and 2.24 km/sec at 850 meters. University of Hawaii measurements on samples of a core from about 850 meters show a compressional wave velocity of 2.53 km/sec. On samples of silicified limestone from 985 meters velocities range from 4.05 to 4.50 km/sec.

Coring disturbances appear to have destroyed any original rigidity in a number of cores studied, and no estimate of shear wave velocity of *in-situ* equivalents is possible in these cases. The most reliable values are summarized here. A section from 312 meters shows a rigidity of 0.073 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of 0.206 km/sec. A section from 411 meters shows a rigidity of 0.618 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of 0.601 km/sec. A section from 710 meters shows a rigidity of 2.00 dynes/cm^2 $\times$ 10^{10}, and a shear wave velocity of 1.02 km/sec. A section from 850 meters shows a rigidity of 2.83 dynes/cm^2 $\times$ 10^{10} and a shear wave velocity of 1.21 km/sec. Materials deeper than 850 meters show indications of core disturbance.

TABLE 8
Measurements of Velocity of Compressional Wave, University of Hawaii, for Samples from Site 64

Hole	Core	Section	Interval (cm)	Lithology	Compressional Wave Velocity km/sec	Note
64.0	7	1	40	Chalk limestone	1.806	
64.0	10	1	27-28	Chalk limestone	2.260	
64.0	10	1	82-83	Chalk limestone	2.196	
64.0	10	1	82-83	Chalk limestone	2.050	
64.0	10	2	36-37	Chalk limestone	2.533	
64.1	1	4		Chalk	1.929	Perpendicular to bedding
64.1	1	4		Chalk	1.740	Parallel to bedding
64.1	6	2		Chalk limestone	1.968	Perpendicular to bedding
64.1	6	2		Chalk limestone	2.110	Parallel to bedding
64.1	7	1		Chalk limestone	2.177	Perpendicular to bedding
64.1	7	1		Chalk limestone	1.950	Perpendicular to bedding
64.1	7	1		Chalk limestone	2.069	Parallel to bedding
64.1	7	CC		Chalk limestone	1.928	
64.1	10	1		Chalk limestone	2.061	
64.1	11	CC		Silicified limestone	4.179	Perpendicular to bedding
64.1	11	CC		Silicified limestone	4.048	Parallel to bedding
64.1	11	CC		Silicified limestone	4.498	Perpendicular to bedding

Site 65

Holes at Site 65 penetrated 185 meters of radiolarian ooze, with some interbedded calcareous ooze below 130 meters. Continuous coring was attempted, and good coverage of measurements of the velocity of the compressional wave were obtained using the shipboard velocimeter. Measurements of compressional wave velocity of the cores are low throughout. The highest velocity measured is 1.54 km/sec, and most values are less than 1.5 km/sec.

Near the bottom of Hole 65.1 chert layers were encountered, and brown chert fragments were recovered in the core catcher of 65.1-6 (about 168 meters below the sea floor). The velocity of the compressional wave of one of these samples was measured at the University of Hawaii. The compressional wave velocity perpendicular to the bedding is 3.457 km/sec; the velocity parallel to the bedding is 3.736 km/sec. The saturated bulk density of chert fragments from this core catcher sample ranged from 2.17 to 2.50 gm/cm^2.

The acoustic impedance of this chert layer (9000 gm/cm^2 sec $\times$ 10^2) constitutes a marked change from the impedance of the overlying radiolarian ooze (1700 gm/cm^2 sec $\times$ 10^2) and this change probably accounts for the reflector on seismic profiles at 0.11 seconds. An increase in drilling rate was also noted at 163 meters (driller's depth).

Gealy and Gerard (1970) found that radiolarian ooze is subject to considerable rebound upon being removed from *in-situ* pressures. Because of this and the inherently high porosity, measurable rigidity is nil in these cores, and shear wave velocity was determinable on only two core sections.

The calcareous beds near 125 meters are more dense than the radiolarian ooze. Acoustic impedance increases abruptly at this level and may cause the reflection seen on the seismic profile at 0.086 seconds. Also, an increase in drilling rate was noted at 127 meters (driller's depth).

Site 66

Holtes at Site 66 penetrated about 160 meters of radiolarian ooze overlying a pelagic clay, the sediment overlying a basalt. About forty per cent of the section was cored and measurements of compressional wave velocity were made on most of these with the shipboard velocimeter.

The sonic velocity of one sample of pelagic clay and one sample of basalt from Site 66 were measured with the University of Hawaii velocimeter. Results are shown in Table 9.

As at Site 65, compressional wave velocities [$V_{p(max.)}$] in the radiolarian ooze are quite low, ranging from about 1.45 to 1.5 km/sec. A few measurements on cores near 180 meters showed maximum values as low as 1.41, but these are probably erroneous.

The pelagic clay has a higher saturated bulk density than the radiolarian ooze (ρ_B = 1.6 gm/cm^3 versus 1.1 gm/cm^3) and also has a higher computed bulk modulus (K = 3.6 dynes/cm^2 $\times$ 10^{10} versus 2.7 dynes/cm^2 $\times$ 10^{10}), yet measurements of compressional wave velocity were lower [$V_{p(max.)}$ = 1.45 km/sec] than those of the overlying ooze [$V_{p(max.)}$ = 1.50 km/sec]. Why this is the case is not known, but there is no reason to believe that measurements in either material are invalid.

Data indicate that cores recovered from Site 66 have a residual rigidity too low to be determined by these techniques and no shear wave velocity could be determined.

Site 67

Core recovery was poor at Site 67 and recovered materials were too badly disturbed to measure sonic velocity with the shipboard velocimeter. However, the velocity of the compressional wave of seven samples from three cores from Site 67 were measured with the University of Hawaii velocimeter. Results are shown on Table 10.

TABLE 9
Measurements of Velocity Compressional Wave, Samples from Site 66 (University of Hawaii)

Hole	Core	Section	Lithology	Compressional Wave Velocity km/sec	Note
66.0	7	3	Stiff pelagic clay	1.613	Perpendicular to bedding
66.0	7	3	Stiff pelagic clay	1.495	Parallel to bedding
66.0	11	CC	Altered basalt	5.131	Perpendicular to bedding
66.0	11	CC	Altered basalt	4.918	Parallel to bedding

TABLE 10
Measurements of Velocity of Compressional Wave, Samples from Site 67 (University of Hawaii)

Hole	Core	Section	Interval (cm)	Lithology	Compressional Wave Velocity km/sec	Note
67.0	1	1	143		2.188	Volcanic sandstone
67.0	1	1	145		1.997	Volcanic mudstone and volcanic sandstone
67.1	1	CC			1.409	Volcanic sandstone (a. direction)
67.1	1	CC			1.564	Volcanic sandstone (b. direction)
67.1	1	CC			1.920	Volcanic sandstone (a. direction)
67.1	1	CC			2.255	Volcanic sandstone (b. direction)
67.1	2	CC			2.742	Chert

DISCUSSION

Velocity Gradients in Pelagic Sediments

Calcareous ooze chalk limestone sequences at Sites 62, 63 and 64 show an irregular exponential increase in compressional wave velocity with depth. Compressional wave velocities are consistently less at Site 64 than at Site 62 and Site 63 (Figure 11). The velocity of the shear wave at all three sites increases with depth. Shear wave velocities at Site 64 are lower throughout than velocities at similar depths at Sites 62 and 63 (Figure 12).

Insufficient reliable data were collected on this Leg to determine velocity gradients in either the radiolarian ooze or the pelagic clay.

Valid measurements of compressional wave velocities are higher throughout than can be inferred from the Wood equation (Wood 1941):

$$V_P = \sqrt{\frac{K}{\rho_B}}$$

These high values result from the increase in rigidity with depth that is so marked at Sites 62, 63, and 64. All marine sediments probably have some rigidity, although values may be too low to measure or to derive by techniques used here.

Low Velocity Channel

At all sites occupied on Leg 7, near surface sediments showed a compressional wave velocity less than that of seawater. At Site 62, this low velocity layer is between 20 and 30 meters thick. Because many of the cores are disturbed at Site 63, it is difficult to determine the thickness of the low velocity layer. The layer at Site 63 is certainly thicker than 10 meters and thinner than 60 meters, and is probably 20 to 30 meters thick as at Site 62. At Site 64, only cores 300 meters and deeper show velocities consistently higher than seawater, and all of the cores retrieved from Sites 65 and 66 show compressional wave velocities less than that of seawater. Because of core disturbances, it is not possible to determine the thickness of the low velocity layer at any of these three sites.

The low velocity layer has also been observed by others. Fry and Raitt (1961) note a sediment layer of lower sound velocity than that of the overlying water in the Pacific. Shumway (1960) notes that velocities for shallow water silts were about 0.978 that of seawater, and for deep sea red clays were as low as 0.98 that of seawater. Hamilton (1956) found *in situ* measurements of comparessional wave velocity of unusually fine-grained high porosity sediments to be 2 to 3 per cent less than the velocity of sound in water. Hamilton (1970) discussed low velocity channels in surficial sediments.

Velocity measurements at Sites 62, 63 and 64 also show a reversal in the orderly increase with depth. A pronounced reversal is noted at Site 62 between 220 and 240 meters. At Site 63, cores between 70 and 130 meters have velocities lower than cores from 65 meters. However, the degree to which these reversals are due to drilling disturbance is uncertain.

Relationship Between Compressional Wave Velocity and Clay Size

It has been noted by Hamilton *et al.* (1966), Shumway (1960), Sutton, *et al.* (1957), Schreiber (1968), Horn *et al.* (1968), and others that a relationship exists between grain size parameters and sonic velocity. Hardin and Richart (1963) and Schon (1963) point out that this relationship derives primarily from the relationship that both of these parameters have with porosity.

The velocity of the compressional wave is dominated by saturated bulk density, compressibility and the rigidity of the sediment; and, a relationship between V_p and grain size should only be apparent when a comparison is made of pairs of samples which differ only in grain size, and are identical in these other parameters. Relationships between grain size and velocity (V_p) may exist only in unconsolidated sediments, and lithification may destroy a preexisting relationship.

Complete grain-size distribution curves are lacking for samples collected on Leg 7, and percentage clay size by weight as reported in Gealy (1971c) is used.

Arrays of values of $V_{p(max.)}$ and percentage clay size by weight were compared for data from Sites 62, 63, 64, 65 and 66, and these are shown on Figure 7. A least squares regression of the data yeilded an equation of the form

$$Y = AX + B$$

where X = fraction clay size

Y = velocity compressional wave in km/sec.

The standard deviation of A and B, and the standard error of estimate for X and for Y were determined, and shown in Table 11.

Despite the wide variation in saturated bulk density and rigidity, data indicate that samples at all sites show a decrease in compressional wave velocity with increase in percentage clay size. Samples from Sites 62, 63 and 64, as expected, show wide scatter, and this scatter undoubtedly reflects the wide range in cementation encountered at these three sites. Samples from Sites 65 and 66, on the other hand, show a close relationship between the two arrays with low standard deviation. and standard errors of estimate.

Anisotrophy

For fifteen samples obtained on Leg 7, the velocity of the compressional wave was measured both parallel to the bedding (V_{pH}) and perpendicular to the bedding (V_{pV}), in order to determine the sense and degree of any anisotrophy in the sediments (Figure 8).

Of the twelve samples of nannofossil chalk ooze from Sites 62, 63 and 64, the ratio V_{pH}/V_{pV} increases with increasing velocity. Samples having a horizontal velocity less than 2.0 showed a higher vertical velocity than horizontal. Those having a horizontal velocity greater than 2.0 showed a lower vertical velocity than horizontal. If more data confirms such a trend, it may be that in semiconsolidated calcareous sediments, advecting fluids may create a vertical "grain" which could account for this effect in low velocity calcareous sediments. Increased compaction may eventually destroy this vertical grain and crush the material into horizontal layers.

Two samples of chert from radiolarian ooze show higher horizontal velocities than vertical. A sample of silicified limestone shows a lower horizontal velocity than vertical. One sample of stiff pelagic clay from Site 66 shows a higher velocity perpendicular to bedding than parallel to it.

REFERENCES

Birch, F., 1966. Compressibility: elastic constants in Handbook of Physical Constant. S. P. Clark Jr. (Ed.), *Geol. Soc. Amer. Memoir.* **97**, 98.

Fry, J. C. and Raitt, R. W., 1961. Sound velocity at the surface of deep sea sediments. *J. Geophys. Res.* **66**, 589.

Gassmann, F., 1951. Uberdie lastizitat poroset medien. V. Naturforsch. Ges. Zurich. **96**, l.

Gealy, E. L. (1971a), Saturated bulk density, grain density and porosity of sediments from the Western Equatorial Pacific: Leg VII, Glomar Challenger, In *Initial Reports of the Deep Sea Drilling Project, Volume VII*, (U. S. Government Printing Office).

Gealy, E. L. (1971b), Carbon-carbonate content of sediments from the Western Equatorial Pacific: Leg VII, Glomar Challenger, In *Initial Reports of the Deep Sea Drilling Project, Volume VII*, (U. S. Government Printing Office).

Gealy, E. L. (1971c), Grainsize of sediments from the Western Equatorial Pacific: Leg VII, Glomar Challenger, In *Initial Reports of the Deep Sea Drilling Project, Volume VII* (U. S. Government Printing Office).

Gealy, E. L. and Gerard, R. D. (1970), *In situ* petrophysical measurements in the Caribbean, In *Initial Reports of the Deep Sea Drilling Project, Volume IV*, Wash., D. C. (U. S. Government Printing Office), p. 269-296.

Hamilton, E. L., 1971. Prediction of *in situ* acoustic and elastic properties of marine sediments. *Geophysics.* **36**, in press April, 1971.

Hamilton, E. L., 1971. Elastic properties of marine sediments. *J. Geophys. Res.* **76**, 579.

Hamilton, E. L., 1970. Sound velocity and related properties of marine sediments, North Pacific. *J. Geophys. Res.* **75**, 4423.

Hamilton, E. L., 1970. Sound channels in surficial marine sediments. *J. Acoust. Soc. Am.* **48**, 1296.

Hamilton, E. L., 1956, Low sound velocities in high-porosity sediments. *J. Acoust. Soc. Am.* **28**, 16.

Hamilton, E. L., Bucker, H. P., Keir, D. L., and Whitney, J. A., 1970. Velocities of compressional and shear waves in marine sediments determined *in*

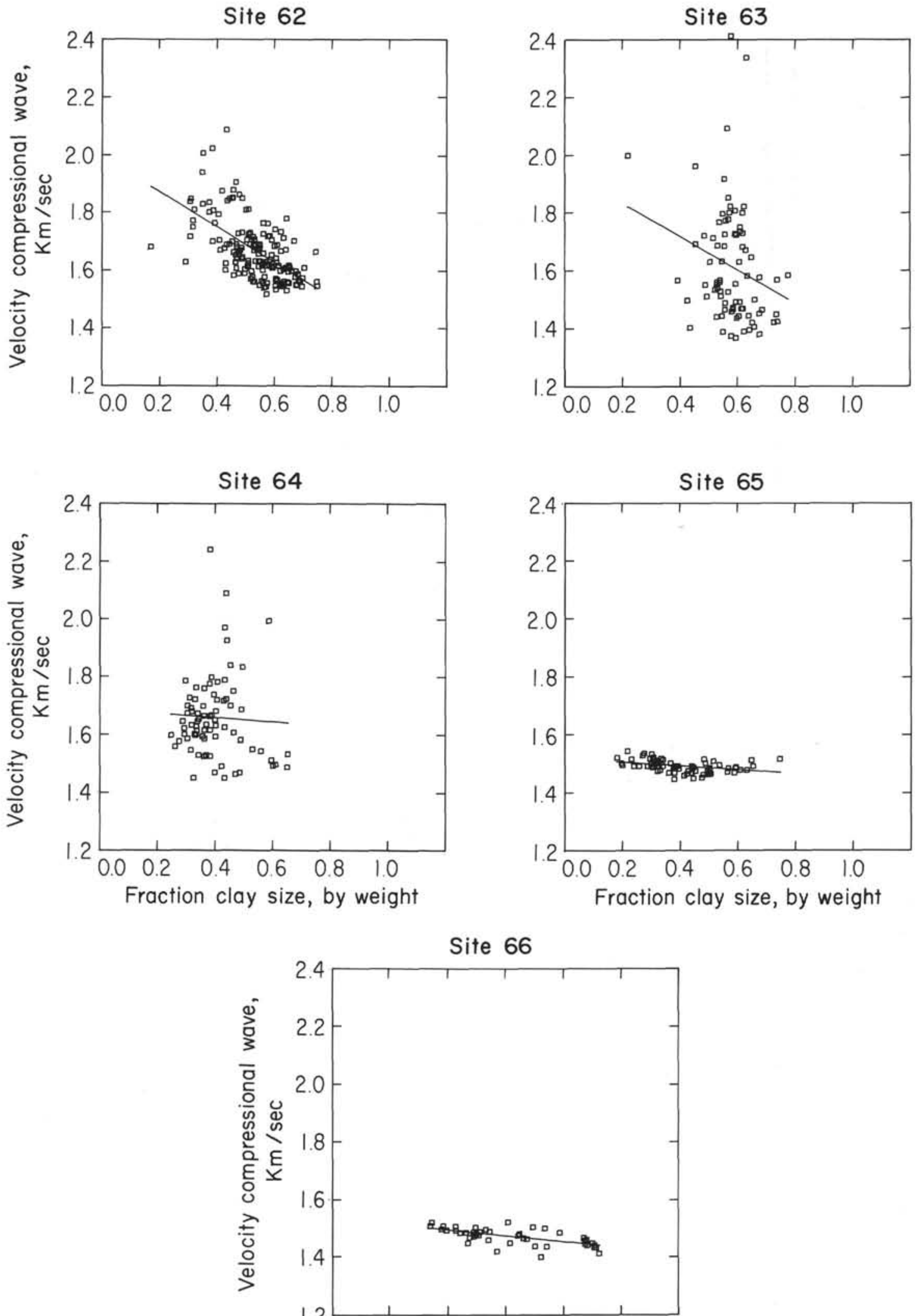

Figure 7. *Comparison of velocity of the compressional wave and per cent clay size by weight.*

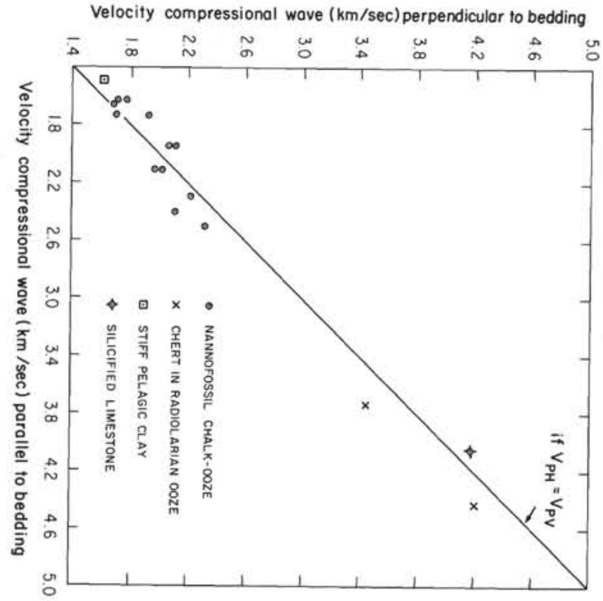

Figure 8. *Comparison of velocity of compressional wave measured horizontally and perpendicular to bedding.*

situ from a research submersible. *J. Geophys. Res.* **75**, (20) July 10, 1970.

Hardin, B. V. and Richart, Jr., F. E., 1963. Elastic wave velocities in granular soils. *J. Soil Mech. Found. Div. Am. Soc. Chem. Engrs.* **89**, SMI, 33.

Horn, D. R., Horn, B. M.,and Delache, M. N., 1968. Correlation between acoustic and other physical properties of deep sea cores. *J. Gepphys. Res.* **73**, 1939.

McManus, Dean, 1970. Comparison of three methods of measuring or estimating sonic velocity in sediments. **In** *Initial Reports of the Deep Sea Drilling Projects, Volume V.* Washington (U.S. Government Printing Office) 545.

Molotova, L. V. and Vassil'ev, Y. J., 1960. Velocity ratio of longitudinal and transverse waves in rocks. *Bull. (Izv.) Akad. Sci. USSR, Geophys. Serv., English Transl.,* No. 8, 731.

NAVOCEANO, 1966. Handbook of Oceanographic Tables. *U. S. Naval Oceanographic Office. SP-68.*

Peselnick, L., 1962. Elastic constants of solenhofen Limestone and their dependence on density and saturation. *J. Geophys. Res.* **67**, 4441.

Peterson, M. N. A. *et. al.,* (1969), *Initial Reports of the Deep Sea Drilling Project, Volume II,* (U. S. Government Printing Office).

Schon, J., 1963. Modellseismische Untersuchungen im Hinblick auf die Schollgeschwinddigkeit in Lockergesteinen, Monatsber. *Deut. Akad. Wiss. Berlin.* **5**, 4, 262.

Schreiber, B. C., 1968. Sound velocity in deep sea sediments. *J. Geophys. Res.* **73**, 1259.

Shumway, G., 1960. Speed and absorption studies of marine sediments by a resonance method, 1 and 2. *Geophysics.* **25**, 451-467, 659-682.

Skempton, A. W., 1961. Effective stress in soils, concrete and rocks. **In** *Pore Pressure and Suction in Soils.* London (Butterworth).

Sutton, G. N., Berckheimer, H. and Nafe, J. E., 1957. Physical analysis of deep sea sediments. *Geophysics.* **22**, 779.

Urick, R. J., 1947. A sound velocity method for determining the compressibility of finely divided substances. *J. Appl. Phys.* **18**, 983.

Wood, D. B., 1941. *A Textbook of Sound.* London (G. Bell), 578 pp.

TABLE 11
Comparison of Compressional Wave and Fraction Clay Size (by weight)

		A		B		Standard Error of Estimate	
Site	Lithology	Value	Standard Deviation	Value	Standard Deviation	X	Y
62	Calcareous ooze-chalk	-0.610	0.016	+1.991	0.030	0.137	0.084
63	Calcareous ooze-chalk	-0.579	0.072	+1.949	0.123	0.338	0.196
64	Calcareous ooze-chalk	-0.071	0.034	+1.685	0.082	1.900	0.138
65	Radiolarian ooze	-0.067	0.004	+1.519	0.009	0.292	0.020
66	Radiolarian ooze, pelagic clay	-0.103	0.005	+1.534	0.008	0.202	0.021

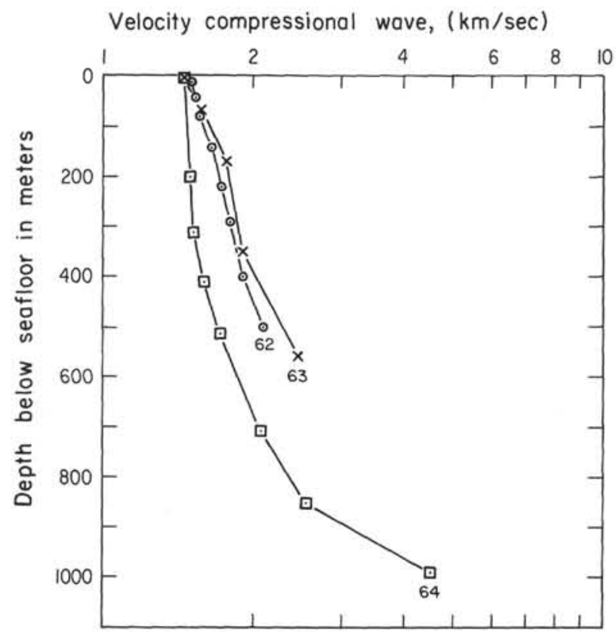

Figure 9. *Velocity compressional waves versus depth (Sites 62, 63 and 64).*

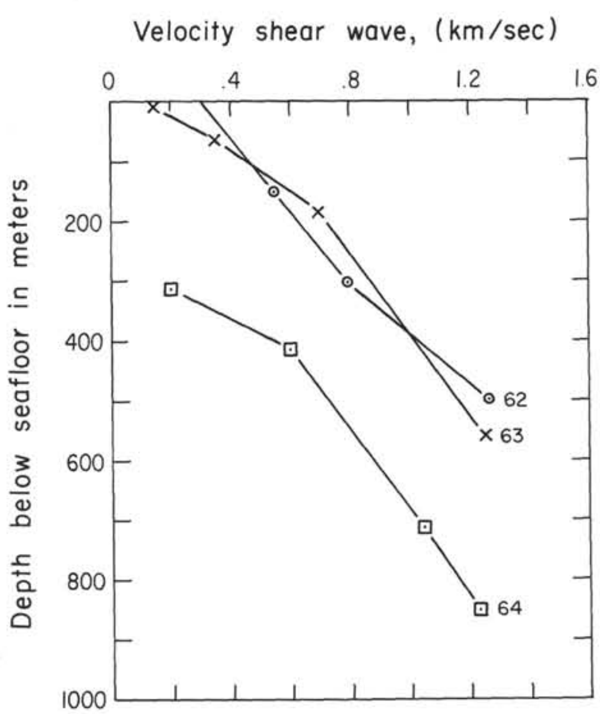

Figure 10. *Velocity shear waves versus depth (Sites 62, 63 and 64).*