Geological Survey of Japan Cruise Report No. 18, p. 124–137, 1982

VI. GEOTECHNICAL PROPERTIES OF DEEP-SEA SEDIMENT, WAKE TO TAHITI

Katsuya Tsurusaki and Takayuki Saito**

Geotechnical properties of deep-sea sediment, vane shear strength (original and remolded strength) and water content, were measured on 26 box cores and 19 piston cores. Adhesiveness between manganese nodule and surficial sediment was also measured on 57 selected nodules of nine undisturbed box cores. The measurements were conducted immediately after recovering the cores from the sea bottom. Instruments and procedure were same as those on GH79–1 reseach cruise (TSURUSAKI and HANDA, 1981). In this chapter the result of measurements on board and its preliminary examination are described.

The relationship between vane shear strength and water content and sample depth on each box core were shown in Fig. VI-1. From the viewpoint of topography, those cores can be classified into four groups such as Mid-Pacific Mountains area, Central Pacific Basin, Manihiki Plateau, and Penrhyn Basin. The result of examination of those geotechnical properties on each classified group was shown in Table VI-1 and Fig. VI-2. Those table and figure show that the geotechnical properties vary corresponding to the topographical provinces. Especially on surficial sediment the geotechnical properties vary obviously reflecting the difference of lithology. Water content of Central Pacific Basin samples which are siliceous pelagic clay and siliceous calicareous clay is highest and that of Penrhyn Basin samples which are zeolitic pelagic clay is next high. That of Manihiki Plateau samples which are calicareous clay is lowest and that of Mid Pacific Mountains area samples which are zeolitic clay is next low. On the other hand, vane shear strength tends in the reverse order of water content. This areal trend, however, cannot be obvious in the deeper part of the sample. Especially the plots of the deeper part of Manihiki Plateau samples scattered very widely as shown in Fig. VI-2. These are thought to due to the lithological change of the sediment layers.

The relationship between geotechnical properties and sample depth on each piston core sample were shown in Fig. VI-3. The latteral dotted line on each profile means visible and invisible lithological change in the cores. In case of homogeneous sediment throughout a core, for example P178 (St. 1642), water content decreases and vane shear strength increases monotonously with increasing sample depth. But many cores include several visible and invisible lithological changes within, and it is thought that lithology gives some influences on the geotechnical properties. For example, core P169 (St. 1626) included several marked deep-sea turbidite layers. It is obvious that water content and vane shear strength of P169 are influenced by the turbidite layers. They show a complicated variation corresponding to each layer as shown in the profile.

Averaged adhesiveness between manganese nodule and surficial sediment was 5.8±

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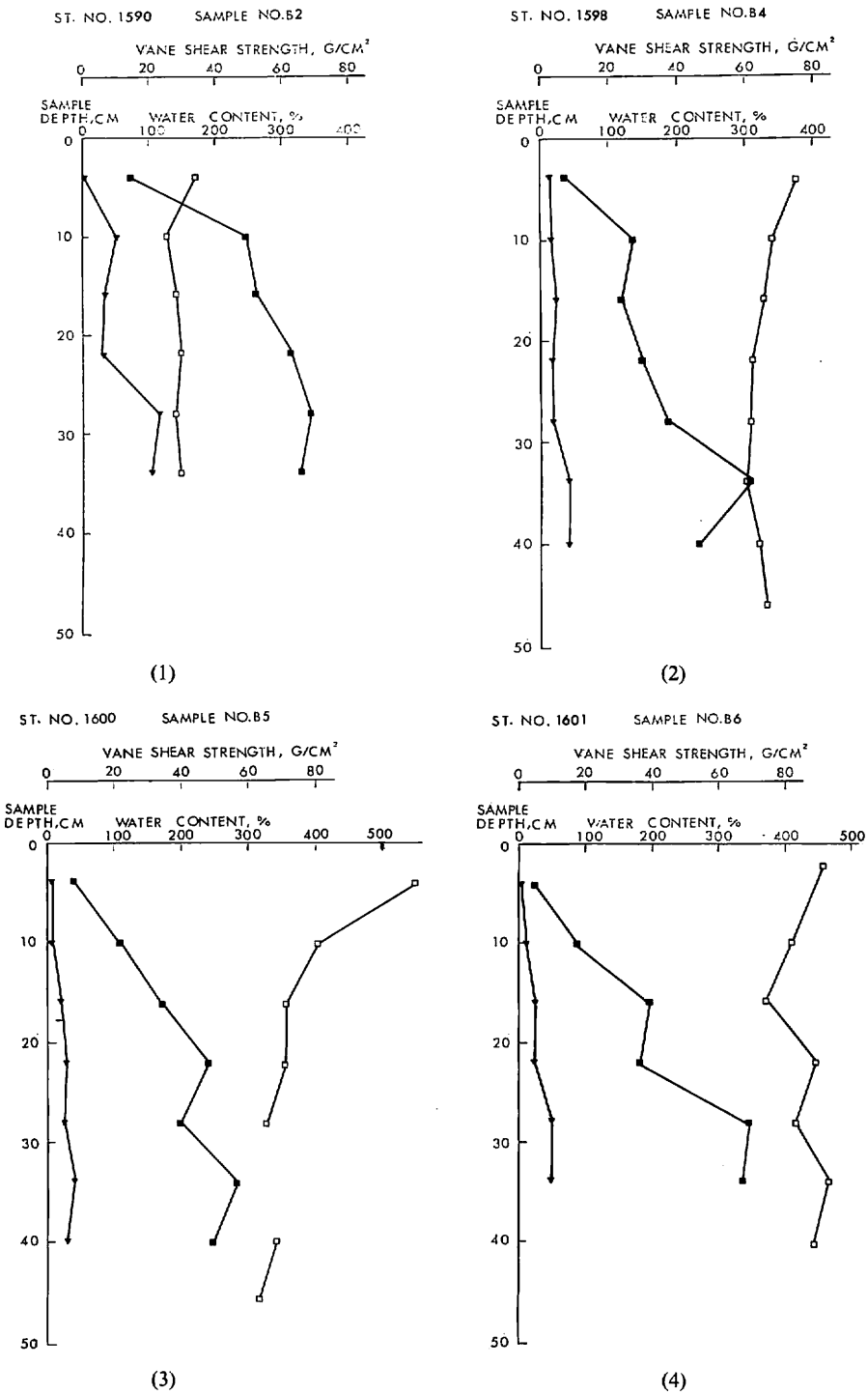
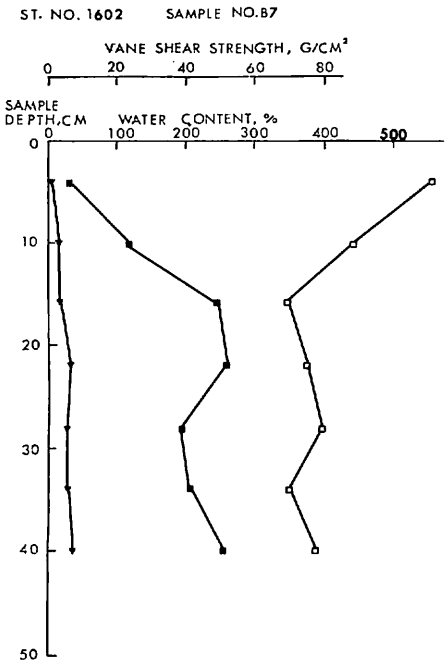


Fig. VI-1 Relationship between geotechnical properties and sample depth of box cores. Open square, water content; solid square, original vane shear strength; solid triangle, remolded shear strength.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SAMPLE DEPTH,CM
WATER CONTENT, %
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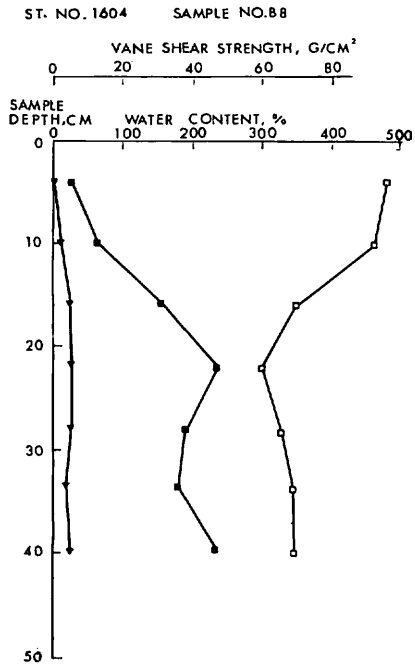
(5)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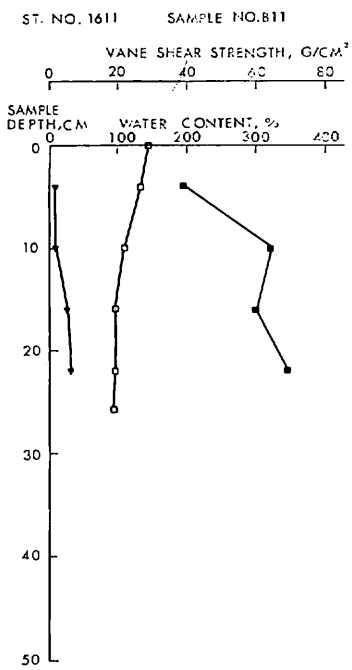
(6)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SAMPLE DEPTH,CM
WATER CONTENT, %
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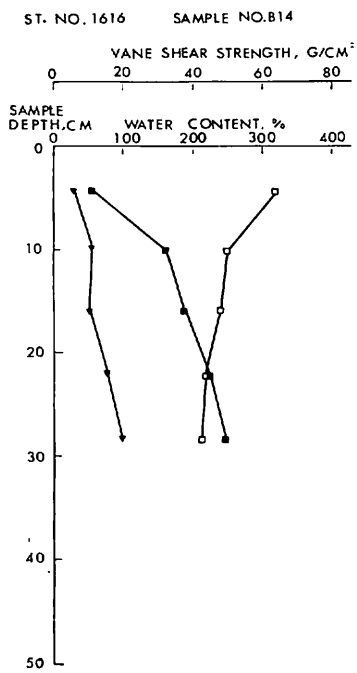
(7)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SAMPLE DEPTH,CM
WATER CONTENT, %
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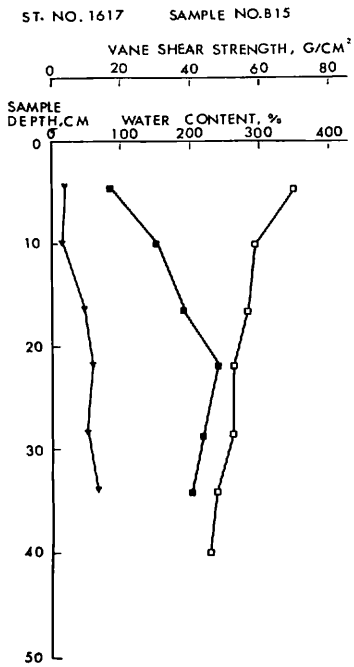
(8)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SAMPLE DEPTH,CM
WATER CONTENT, %
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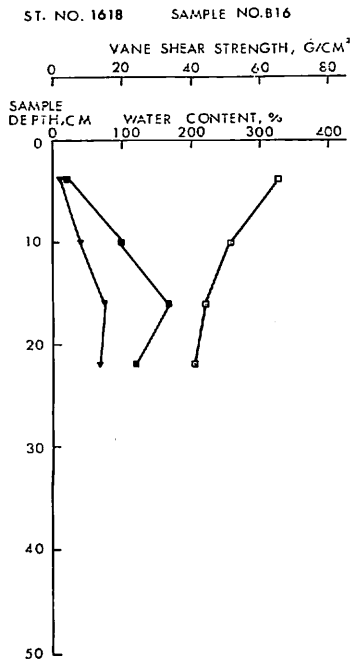
(9)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SAMPLE DEPTH,CM
WATER CONTENT, %
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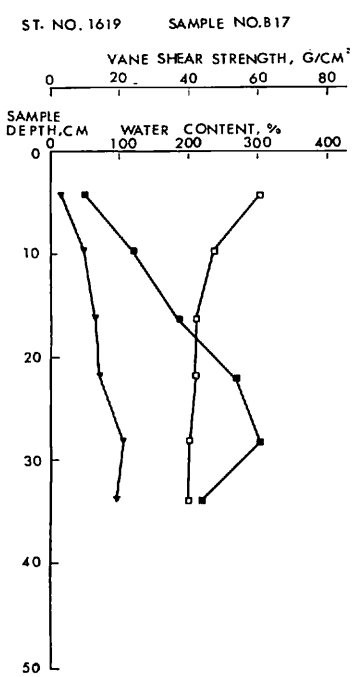
(10)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SAMPLE DEPTH,CM
WATER CONTENT, %
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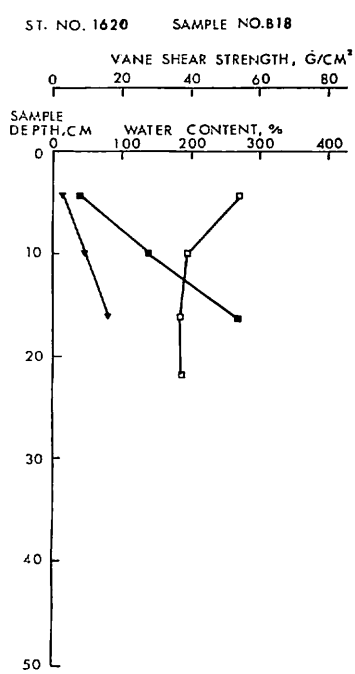
0 10 20 30 40 50

(11)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SAMPLE DEPTH,CM
WATER CONTENT, %
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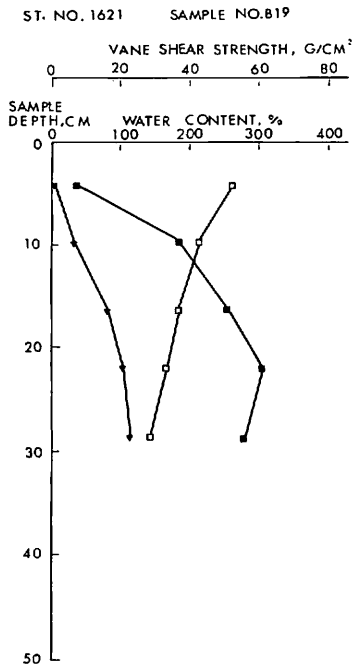
(12)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SAMPLE DEPTH,CM
WATER CONTENT, %
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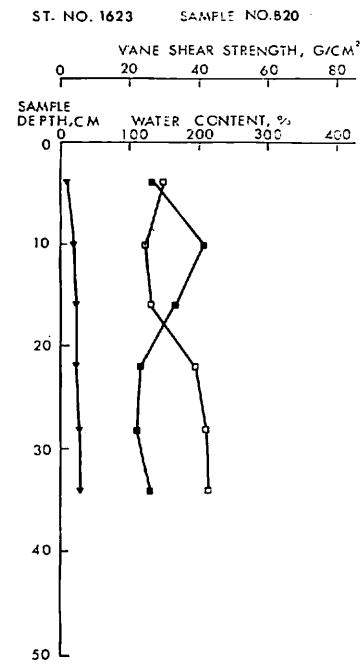
(13)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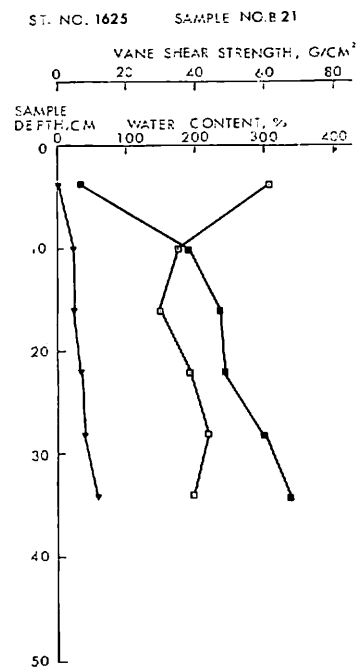
SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400
0 10 20 30 40 50

(14)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT, %
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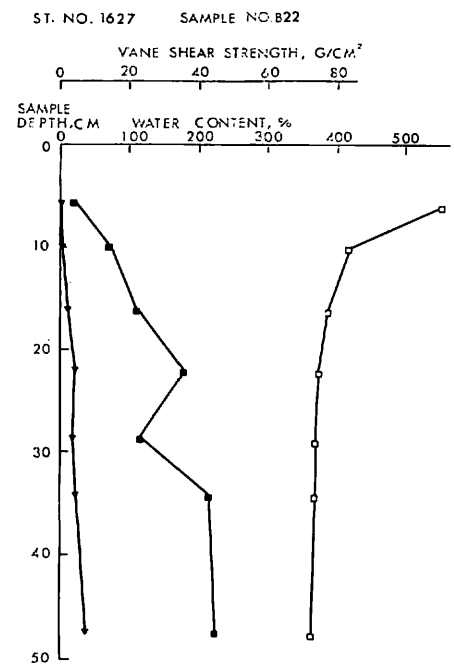
0 10 20 30 40 50

(15)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VANE SHEAR STRENGTH, G/CM²
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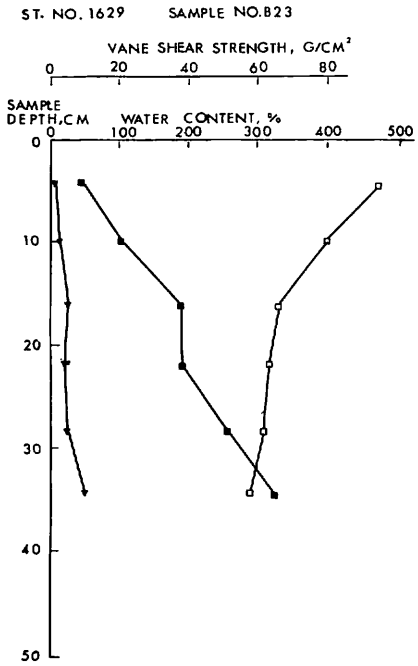
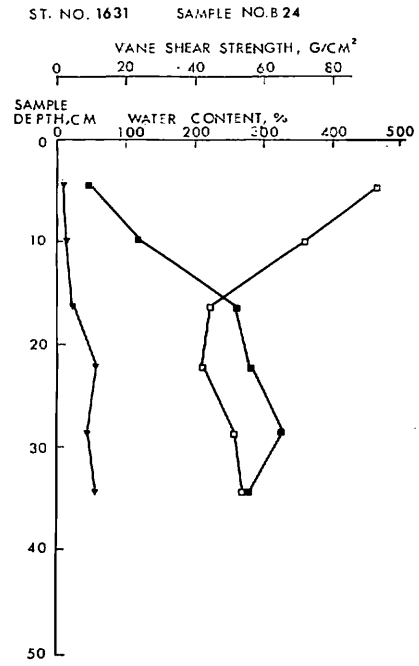
SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400 500
0 10 20 30 40 50

(16)


ST. NO. 1629 SAMPLE NO.B23
VANE SHEAR STRENGTH, G/CM²
0 20 40 60 80
SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400 500
0 10 20 30 40 50

(17)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT, %
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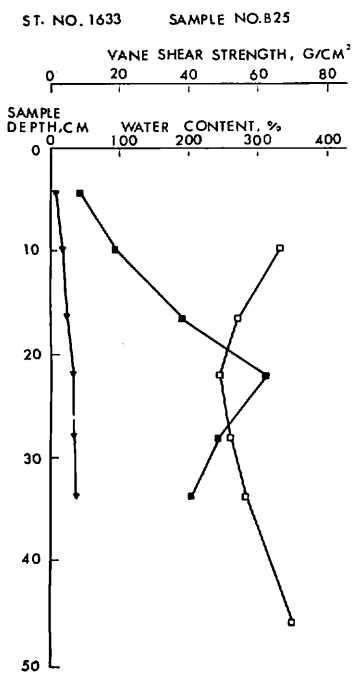
0 10 20 30 40 50

(18)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VANE SHEAR STRENGTH, G/CM²
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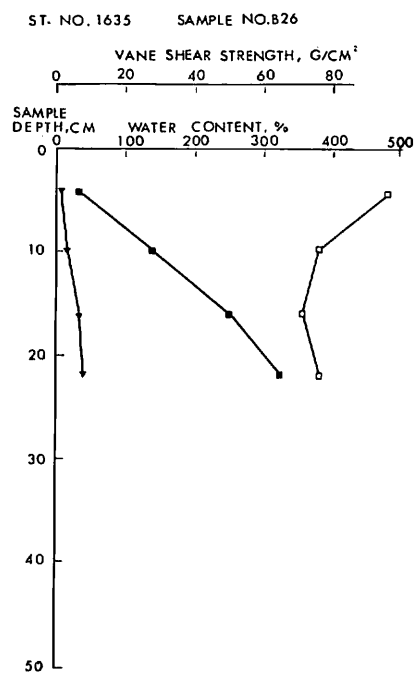
SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400
0 10 20 30 40 50

(19)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT, %
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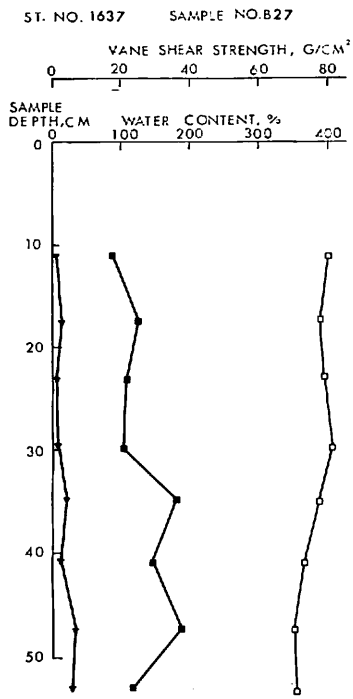
0 10 20 30 40 50

(20)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT, %
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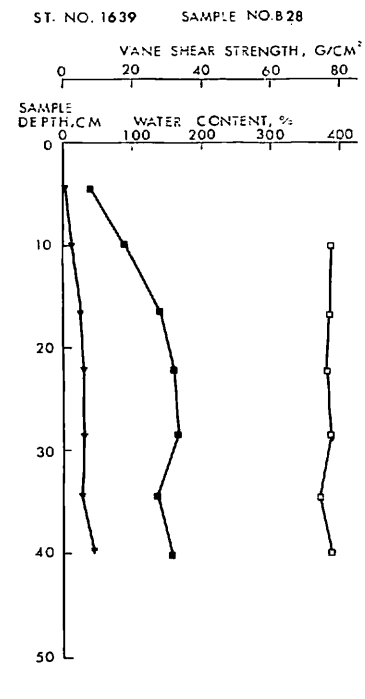
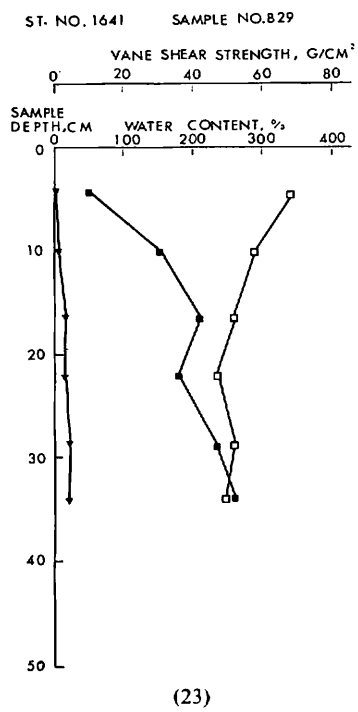
0 10 20 30 40 50

(21)


ST. NO. 1639 SAMPLE NO.B28
VANE SHEAR STRENGTH, G/CM²
0 20 40 60 80
SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400
0 10 20 30 40 50

(22)


ST. NO. 1641 SAMPLE NO.B29
VANE SHEAR STRENGTH, G/CM²
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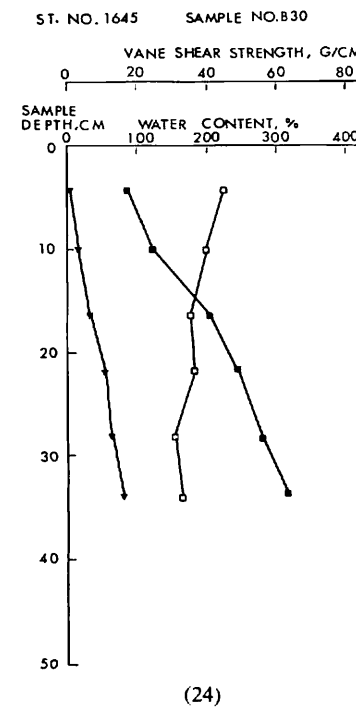
SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400
0 10 20 30 40 50

(23)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT, %
0 100 200 300 400
0 10 20 30 40 50

(24)

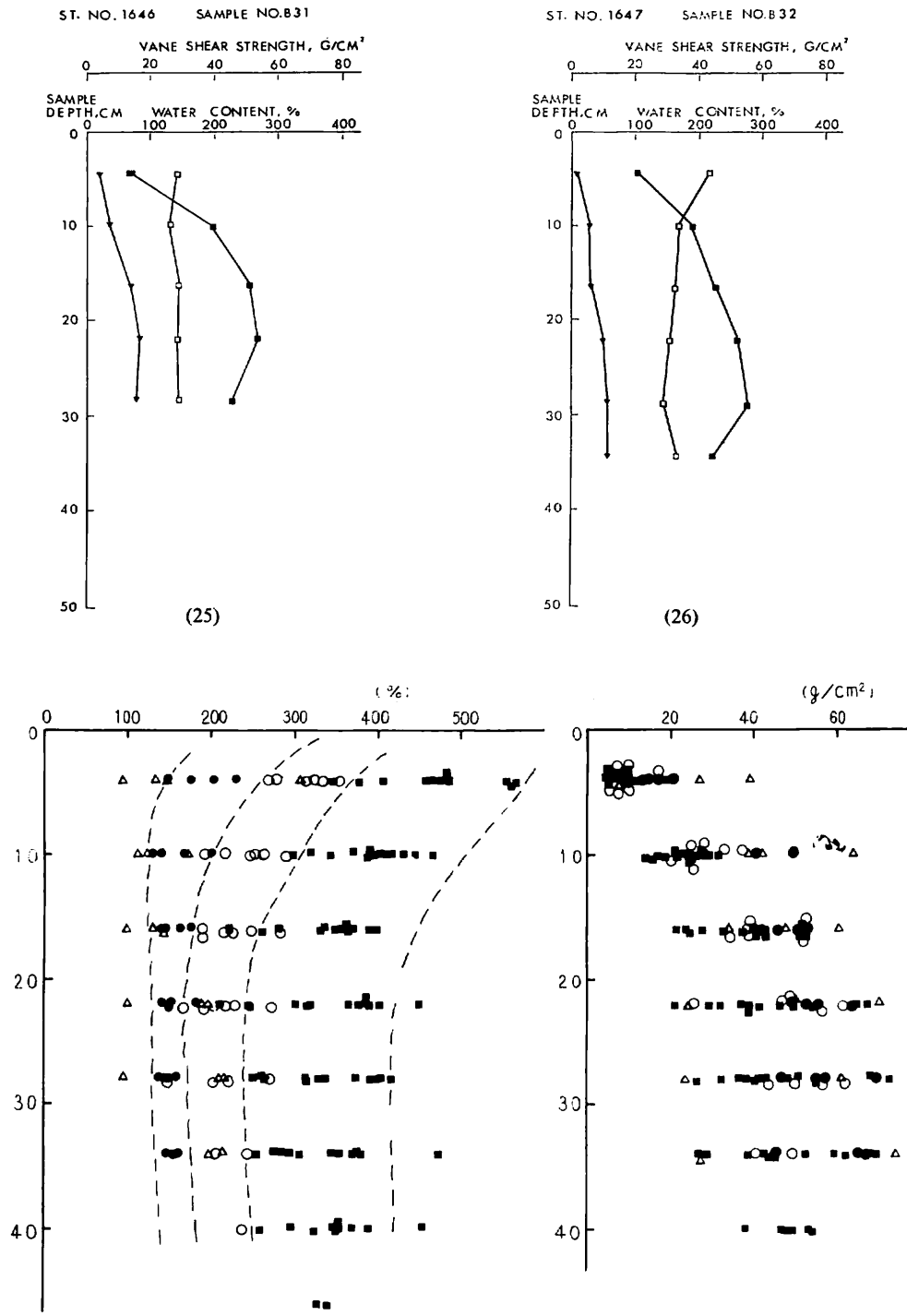


Fig. VI-2 Summarized figure of the relationship between geotechnical properties and sample depth of box cores. The left and the right figures show the distribution of water content and vane shear strength, respectively. Vertical axis show a sample depth in cm. Solid square, Central Pacific Basin; solid circle, Mid-Pacific Mountains area; open circle, Penrhyn Basin; open triangle, Manihiki Plateau.

Table VI-1 Relationship between geotechnical properties and topographical group.

sample depth (cm)	topographical group	vane shear strength (g/cm^2)				water content (%)			
		No.	Max.	Min.	Ave.	No.	Max.	Min.	Ave.
4	MPM	4	20.5	13.6	16.4	4	229	147	186
	CPBn	4	18.8	7.2	11.4	3	405	345	376
	CPBc, s	9	9.2	4.1	6.8	9	752	458	531
	MP	3	38.9	6.8	24.2	4	307	133	181
	PB	6	17.7	4.1	9.5	6	352	268	308
16	MPM	4	52.9	41.6	47.8	4	176	143	157
	CPBn	4	43.0	21.8	29.2	4	392	261	343
	CPBc, s	9	51.5	22.8	39.8	9	369	221	335
	MP	3	60.0	33.4	46.8	3	147	99	126
	PB	6	52.5	33.8	42.4	6	281	185	223
28	MPM	4	69.9	46.7	57.1	4	158	143	149
	CPB	4	48.8	32.1	38.6	4	397	265	342
	CPBc, s	8	70.2	23.9	47.5	8	413	251	334
	MP	2	60.7	22.8	41.8	3	216	95	174
	PB	4	61.4	43.3	52.7	4	268	146	207

MPM: Mid-Pacific Mountains area.
MP: Manihiki Plateau.
CPBn, c, s: Central Pacific Basin.
PB: Penrhyn Basin.

1.9 gr/cm^2 (per nodule projection area).

Description above is a preliminary result obtained on the board, and subsequent laboratory geotechnical examinations are to be carried out altogether with lithological and topographical examination for detailed geotechnical study of deep-sea sediment.

Reference

TSURUSAKI, K. and HANDA, K. (1981) Geotechnical properties of deep sea sediments in the northern part of Central Pacific Basin. *In* MIZUNO, A. (*ed.*), *Geol. Surv. Japan Cruise Rept.*, no. 15, p. 143–161.

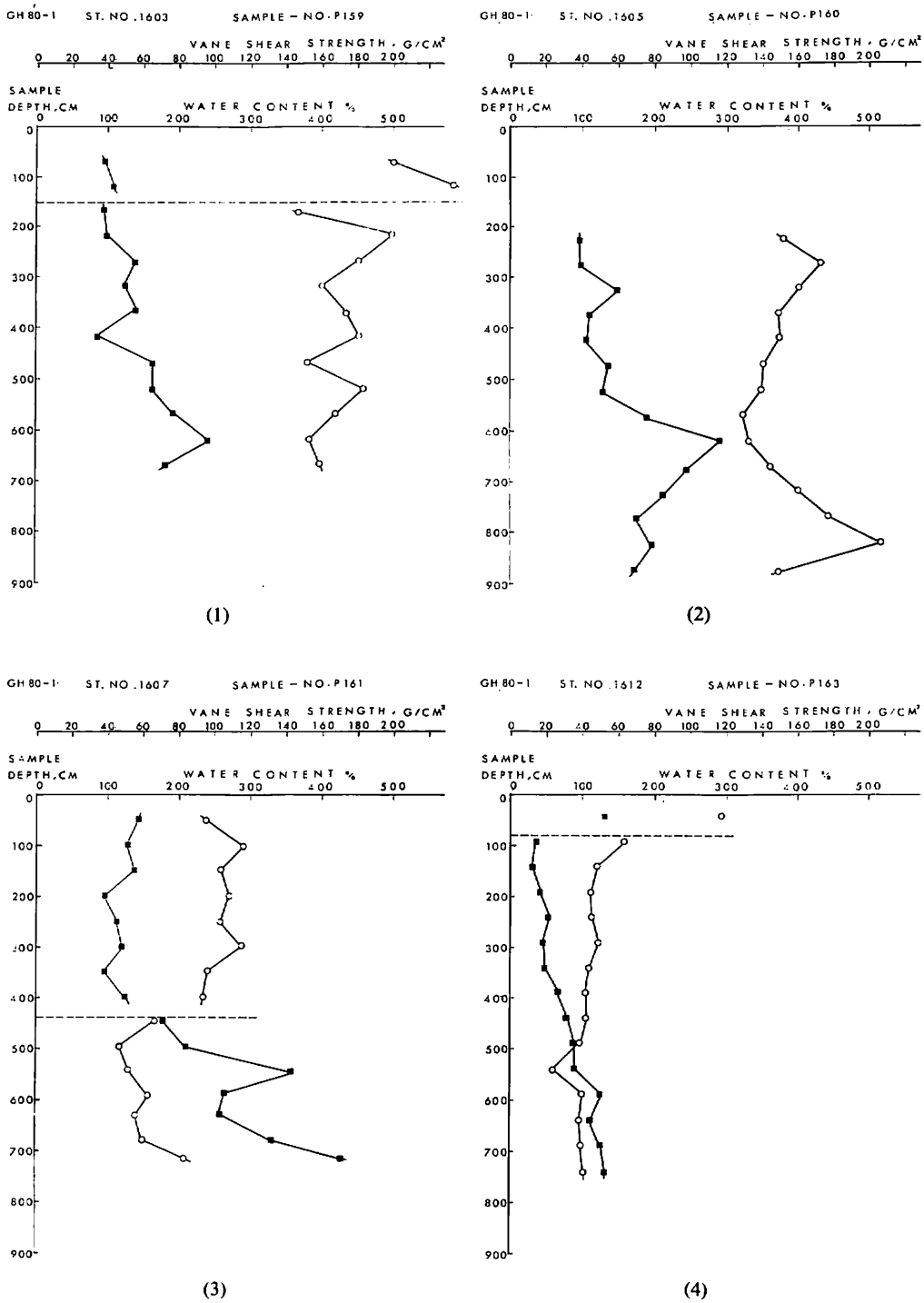
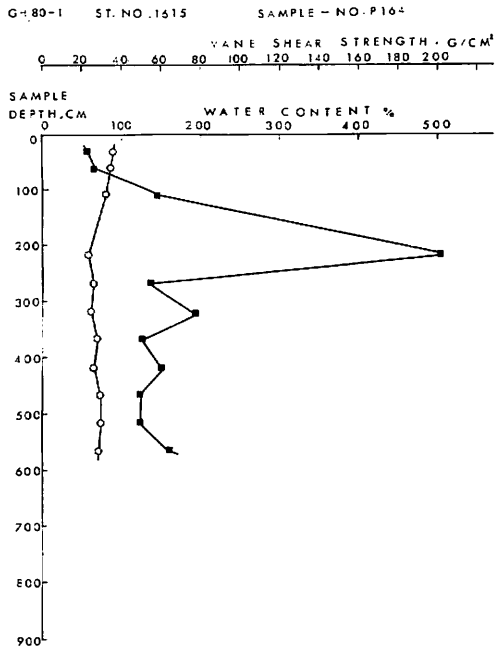


Fig. VI-3 Relationship between geotechnical properties and sample depth of piston cores. Solid square, original vane shear strength; open circle, water content.


GH 80-1 ST. NO .1615 SAMPLE – NO·P164
VANE SHEAR STRENGTH , G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT %
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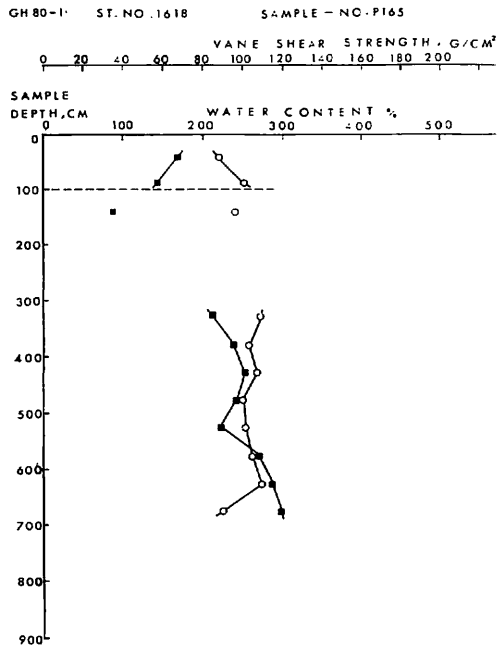
0 100 200 300 400 500 600 700 800 900

(5)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VANE SHEAR STRENGTH , G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT %
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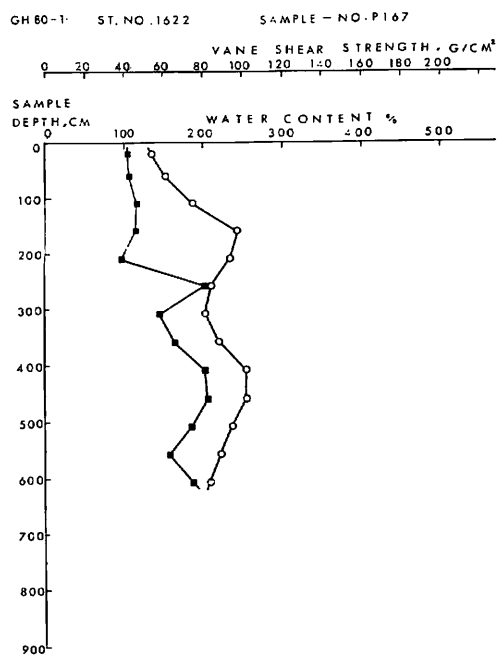
0 100 200 300 400 500 600 700 800 900

(6)


GH 80-1 ST. NO .1622 SAMPLE – NO·P167
VANE SHEAR STRENGTH , G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT %
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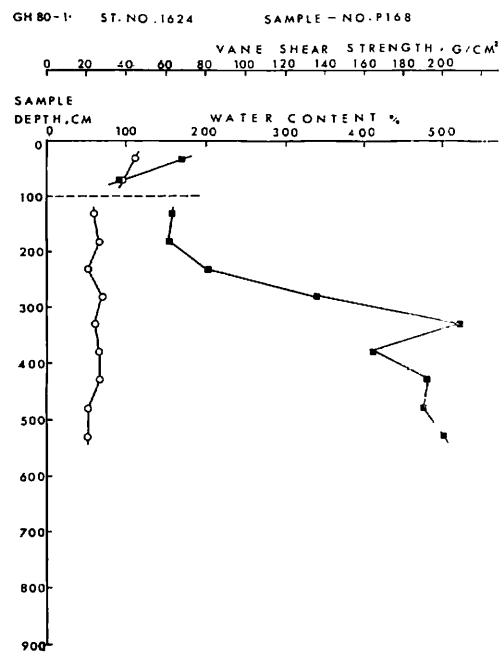
0 100 200 300 400 500 600 700 800 900

(7)


GH 80-1 ST. NO .1624 SAMPLE – NO·P168
VANE SHEAR STRENGTH , G/CM²
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SAMPLE DEPTH,CM
WATER CONTENT %
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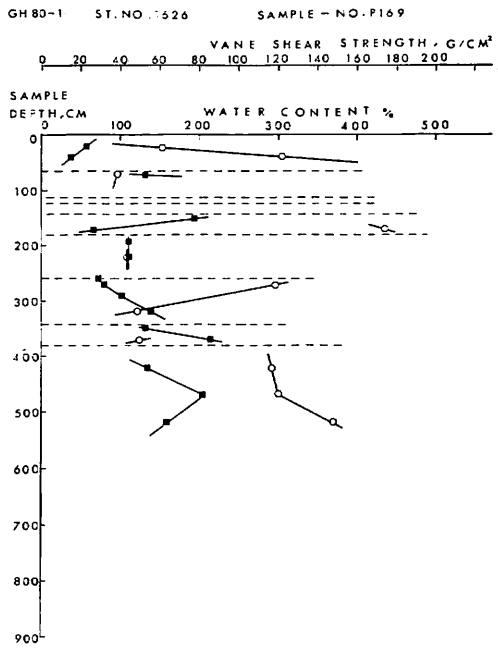
0 100 200 300 400 500 600 700 800 900

(8)


GH 80-1 ST. NO. 1626 SAMPLE – NO. P169
VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH, CM
WATER CONTENT %
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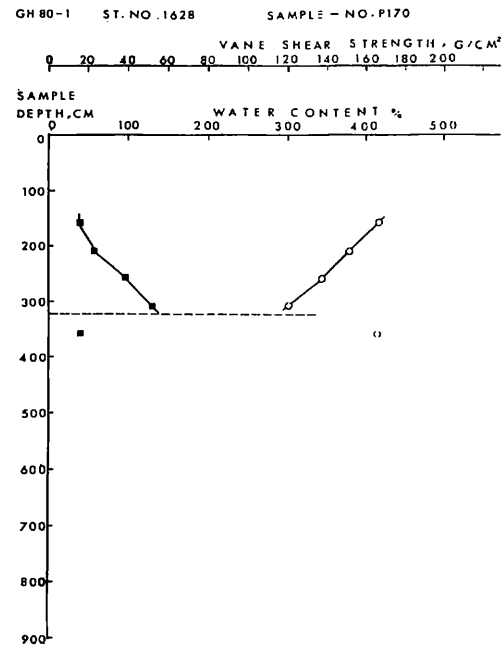
0 100 200 300 400 500 600 700 800 900

(9)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH, CM
WATER CONTENT %
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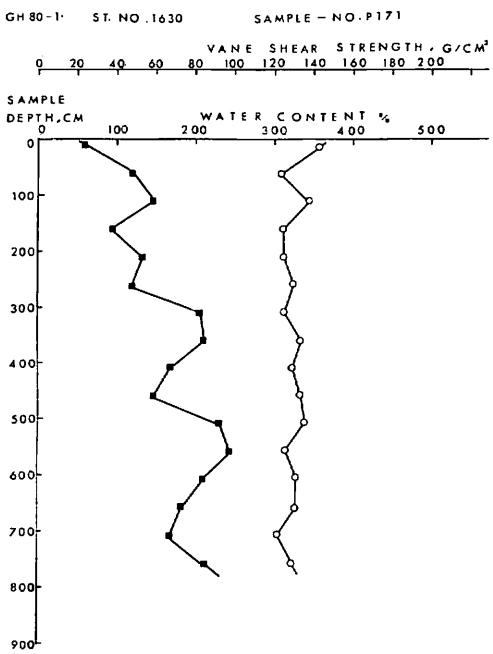
(10)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SAMPLE DEPTH, CM
WATER CONTENT %
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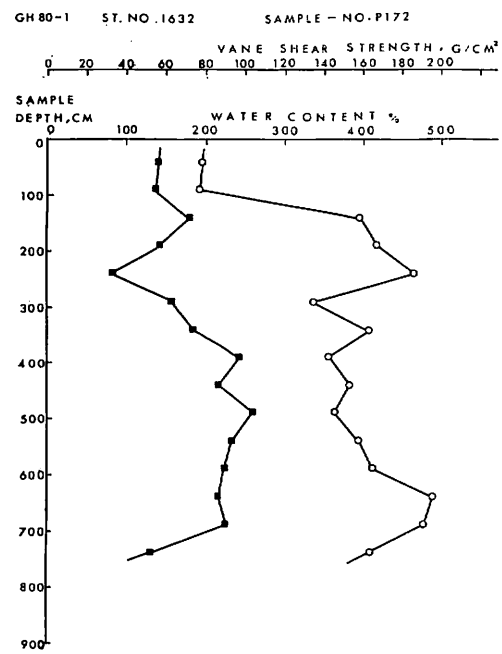
0 100 200 300 400 500 600 700 800 900

(11)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VANE SHEAR STRENGTH, G/CM²
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SAMPLE DEPTH, CM
WATER CONTENT %
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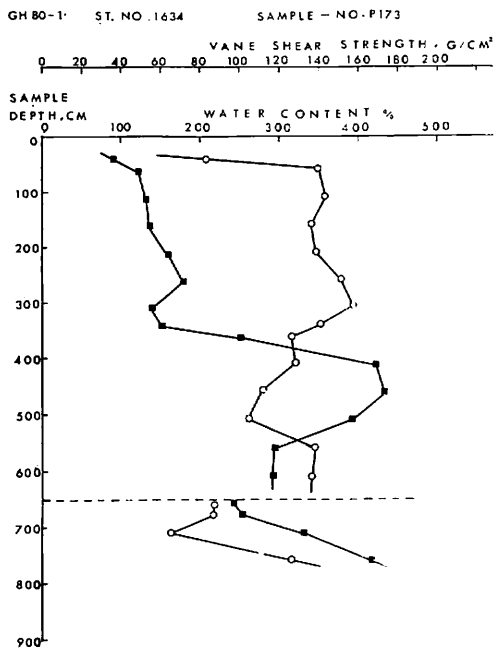
0 100 200 300 400 500 600 700 800 900

(12)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SAMPLE DEPTH,CM
WATER CONTENT %
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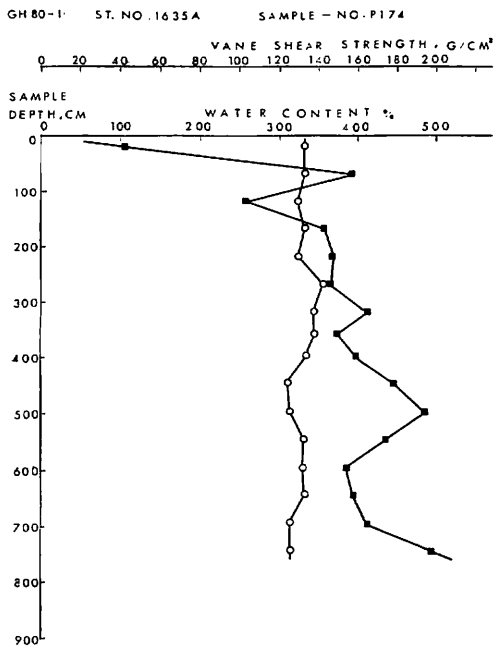
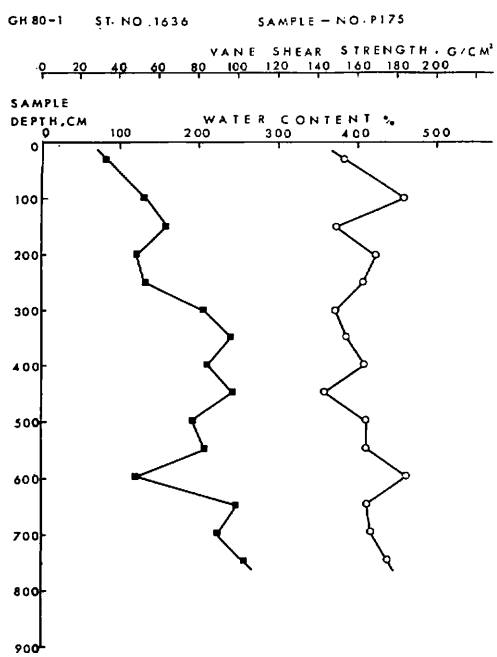
0 100 200 300 400 500 600 700 800 900

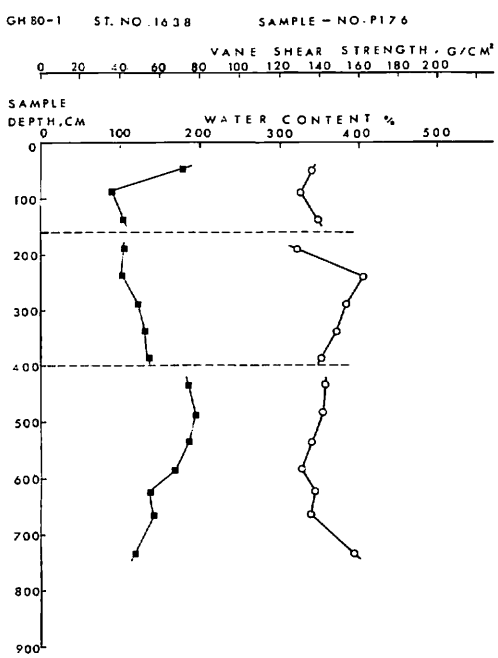
(13)


GH 80-1 ST. NO .1635A SAMPLE – NO·P174
VANE SHEAR STRENGTH, G/CM²
0 20 40 60 80 100 120 140 160 180 200
SAMPLE DEPTH,CM
WATER CONTENT %
0 100 200 300 400 500
0 100 200 300 400 500 600 700 800 900

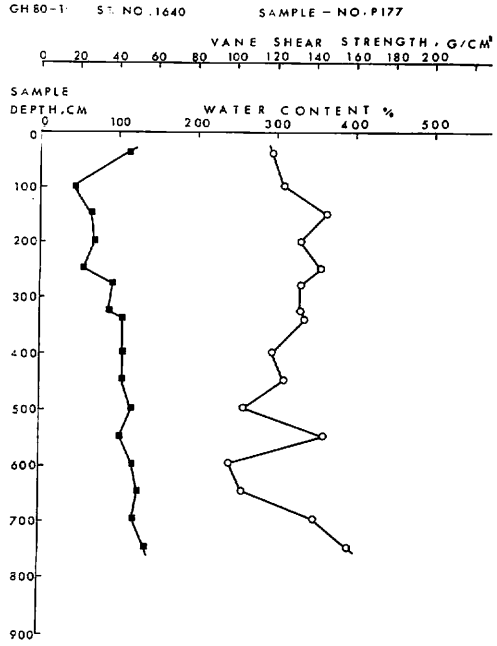
(14)


GH 80-1 ST. NO .1636 SAMPLE – NO·P175
VANE SHEAR STRENGTH, G/CM²
0 20 40 60 80 100 120 140 160 180 200
SAMPLE DEPTH,CM
WATER CONTENT %
0 100 200 300 400 500
0 100 200 300 400 500 600 700 800 900

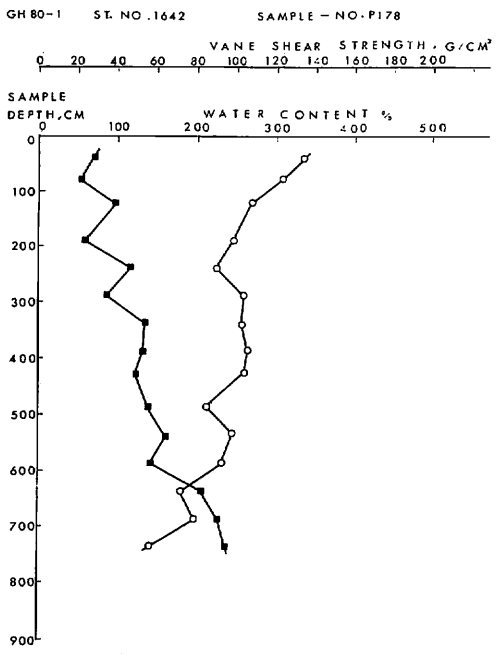
(15)


GH 80-1 ST. NO .1638 SAMPLE – NO·P176
VANE SHEAR STRENGTH, G/CM²
0 20 40 60 80 100 120 140 160 180 200
SAMPLE DEPTH,CM
WATER CONTENT %
0 100 200 300 400 500
0 100 200 300 400 500 600 700 800 900

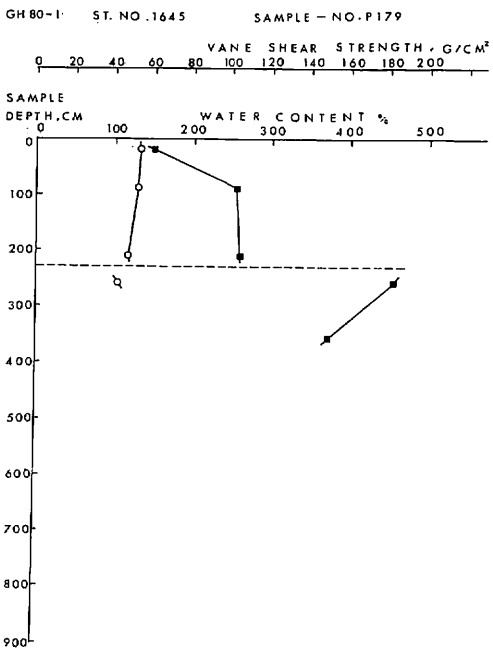
(16)


GH 80-1 ST. NO .1640 SAMPLE – NO·P177
VANE SHEAR STRENGTH , G/CM²
0 20 40 60 80 100 120 140 160 180 200
SAMPLE DEPTH,CM
WATER CONTENT %
0 100 200 300 400 500
0 100 200 300 400 500 600 700 800 900

(17)


GH 80-1 ST. NO .1642 SAMPLE – NO·P178
VANE SHEAR STRENGTH , G/CM²
0 20 40 60 80 100 120 140 160 180 200
SAMPLE DEPTH,CM
WATER CONTENT %
0 100 200 300 400 500
0 100 200 300 400 500 600 700 800 900

(18)


GH 80-1 ST. NO .1645 SAMPLE – NO·P179
VANE SHEAR STRENGTH , G/CM²
0 20 40 60 80 100 120 140 160 180 200
SAMPLE DEPTH,CM
WATER CONTENT %
0 100 200 300 400 500
0 100 200 300 400 500 600 700 800 900

(19)