



Size Distribution of Bottom Sediment in the South China Sea

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Training Department**

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ABSTRACT

The study of size distribution of bottom sediment was conducted in three areas of the South China Sea during 1995 to 1999 consisting of the Gulf of Thailand and East Coast of Peninsular Malaysia, West Coast of Sabah, Sarawak and Brunei Darussalam and Vietnamese waters. *Sand* and *silt* is the main on the bottom of the South China Sea with accounting for 26.26% and 24.57% respectively. *Sandy silt*, *silty sand*, *clay*, *sand and shell* and *sand and stone* accounts for 22.86%, 16.57%, 6.86%, 2.29% and 0.57%, respectively. Sand was rich in the Southern part of Thailand, Peninsular Malaysia and the Southern part of Vietnam. *Silt* was abundant in the Gulf of Thailand, off shore of Sabah and Northern part of Vietnam. *Sandy silt* was dispersed in the Gulf of Thailand and near the shore of Sabah Sarawak. *Silty sand* covers the bottom in Southern part of Thailand and off-shore of Sabah Sarawak. *Clay* is spread in off-shore of Sabah. A mixture of *sand and shell* appears in the Peninsular Malaysia and Southern part of Vietnam. *Sand and stone* is diffused in the Central part of Vietnam.

Key words : bottom sediment, size distribution, South China Sea.

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1. Introduction

Sediments are known to be the key to ancient and historical environments. A sequence of sedimentary layers can tell us about environment changes over time (Hallberg, 1992). The size of sediment describes the type of sediment and the source of both. Analysis of the particle size and shape may provide important clues to the sediment provenance, transport, history, and deposition conditions also (Kenneth 1994).

In this study the main objective was to investigate the size distribution of the bottom sediment in the South China Sea. The sediment type in the upper layer from all sampling stations gives a broad view of the sediment distribution. The results from this study will be useful fundamental data in terms of the relationship between size of sediment and the living marine animal in case that sediment is the substrate of marine benthic fauna and the substrate conditions are an important factor in their distribution and abundance.

Three areas were selected under the joint research project that was carried out by Southeast Asian Fisheries Development Center/ Training Department (SEAFDEC/TD) and the SEAFDEC Marine Fishery Resources Development and Management Department (MFRDMD/ Malaysia) in setting up a Collaborative Research project in the Gulf of Thailand and East Coast of Peninsular Malaysia and West Coast of Sabah, Sarawak and Brunei Darussalam between 23 April to 23 May 1996 and 25 April to 31 May 1997, respectively. Collaboration between TD and Vietnamese Fishery Institute was set up to carry out collaborative research in Vietnamese waters between 25 April to 25 June 1999. All the surveys were carried using M.V. SEAFDEC.

Judging from the literature reviews a few studies concerning the size distribution in the South China Sea have been conducted. In the Gulf of Thailand, almost all researchers in the former times had concentrated only in the area close to the rivers discharging into the upper Gulf of Thailand.

2. The Study Area

The South China Sea is one of the largest continental semi-closed seas with an area about 3,600,000 km². The mean depth is 1,180 m. The greatest depth is in the central basin at about 5,000 m (D.V. Uu and J-M Brankart, 1997). Three areas in the South China Sea were studied. Firstly the Gulf of Thailand and Peninsular Malaysia starting from longitude 99° E to 104° E and from 2° N to 12° N where the average depth is 54 m. Secondly, the waters of West Coast of Sabah, Sarawak and Brunei Darussalam starting from longitude 109° E to 117° E and 5° N to 7° N, where the near shore depth is 0 m to 70 m and off-shore depth exceeds 1000 m. Thirdly Vietnamese waters starting from 103° E to 112° E and from 21° N to 7° N, in the Northern part characterized by shallow, wide

continental shelf with a water depth from 10 m to 30 m. The central part characterized by a narrow continental shelf. Its width is being 40 km to 50 km after that the water depth reaches 1000 m to 2000 m. The southern part is characterized by a wide continental shelf where the water depth is from 20m to 60 m. The depth contours has been illustrated in Fig 1.

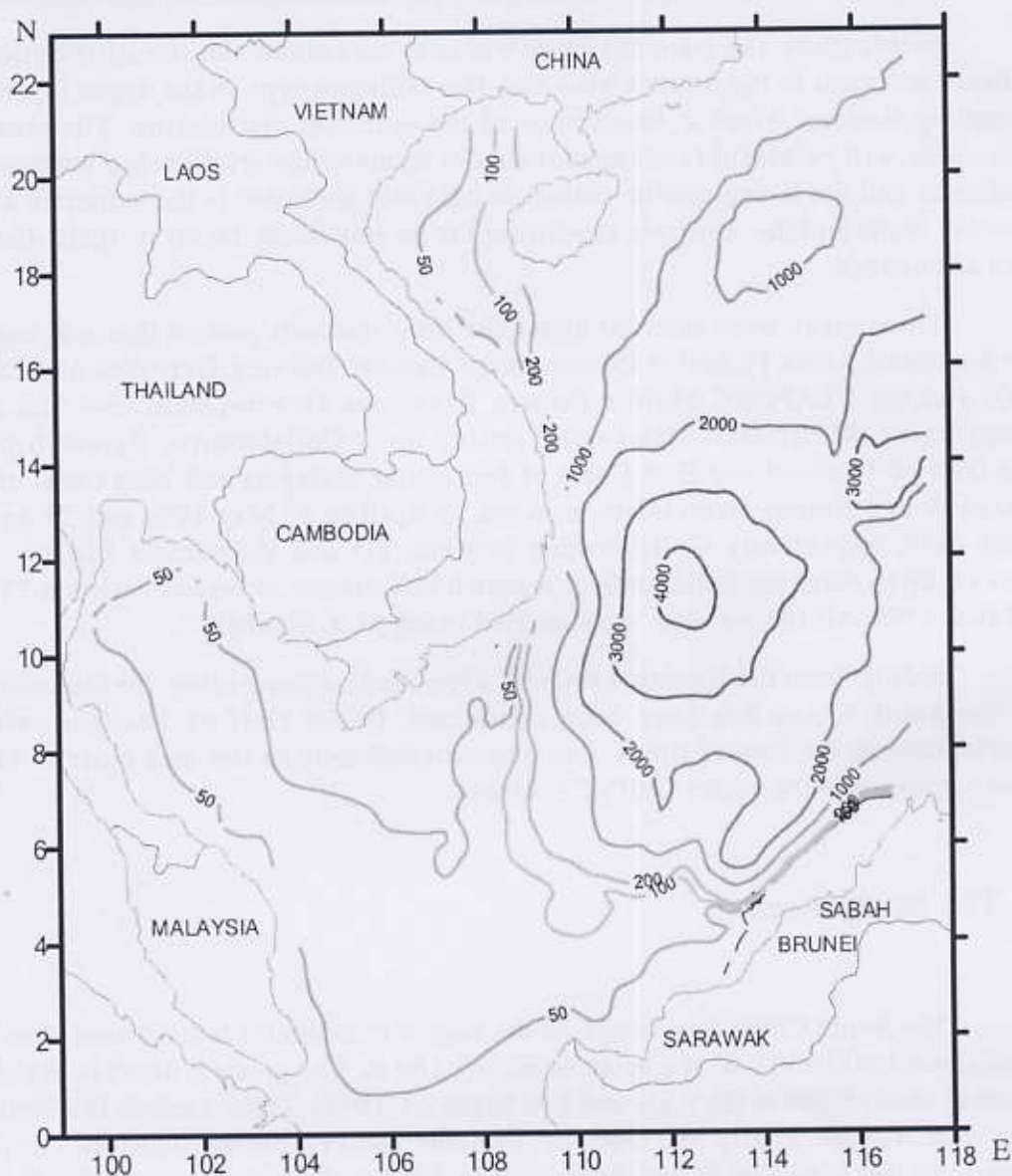


Fig. 1. Depth contour of the South China Sea.

3. Materials and Methods

Collection of Sediment Samples

The samples were collected using a gravity corer (see Fig. 2 and Fig. 3) that consisting of a core barrel of hollow metal. The core barrel contains removable plastic liners which fit into a core barrel and retain the sediment sample, the plastic liner was 85 cm long and 5.2 cm in inside diameter. During sediment collection, the gravity corer was lowered to the depth of about 2 m above the sea bottom in shallow water (less than 300m) then stopped 1 to 2 min. Subsequently it was allowed to sink freely to the bottom. Additionally a Smith-McIntyre grab that area covered being 0.05 m² (see Fig. 4) was used in a few stations instead of the corer where the bottom was composed mainly of sand and gravel that could not be retrieve by the corer. A big gravity corer was use instead of the small gravity corer in Sabah, Sarawak and Brunei Darussalam waters in the last seven sampling station. The length of the plastic liner was 120 cm and the diameter was 9.5 cm.

Eighty-one sampling stations were chosen in the Gulf of Thailand and East Coast of Peninsular Malaysia. Sixty-four sampling stations were chosen in West Coast of Sabah, Sarawak and Brunei Darussalam and thirty- four sampling stations were sampled in Vietnamese waters. The sampling stations are shown in been illustrated in Fig. 5.

Sediment Analysis

The length of sediment core was measured then the appearances of the sediment were recorded by visual observation. A fine grain size of rock represented being **sand**, fine grain size and soft sediment represented **silt**, and a fine stricky grain size was classed as **clay**. Amount of clay more than silt represented **silty clay**, amount of sand more than silt represented **silty sand**, amount of silt more than sand represented **sandy silt**, sand mixed shell is classed as **sand and shell**, and sand with stone represented **sand and stone**. Apart from this, the homogeneous sediment core (the same size of sediment through the sediment core) will be recorded.

A surface layer (2 cm of the upper layer) of all sediment cores and the homogeneous sediment core were used to plot an image of the size distribution in the South China Sea.

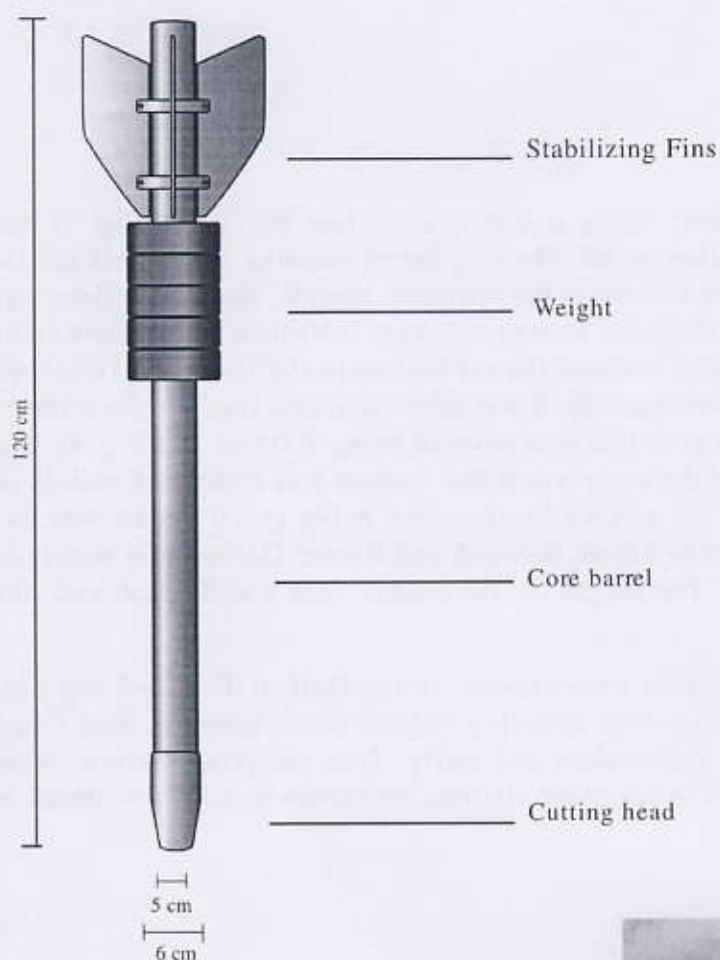


Fig.2. The gravity corer.



Fig. 3. The sediment sampling using gravity corer.



Fig. 4. Smith-McIntyre Grab.

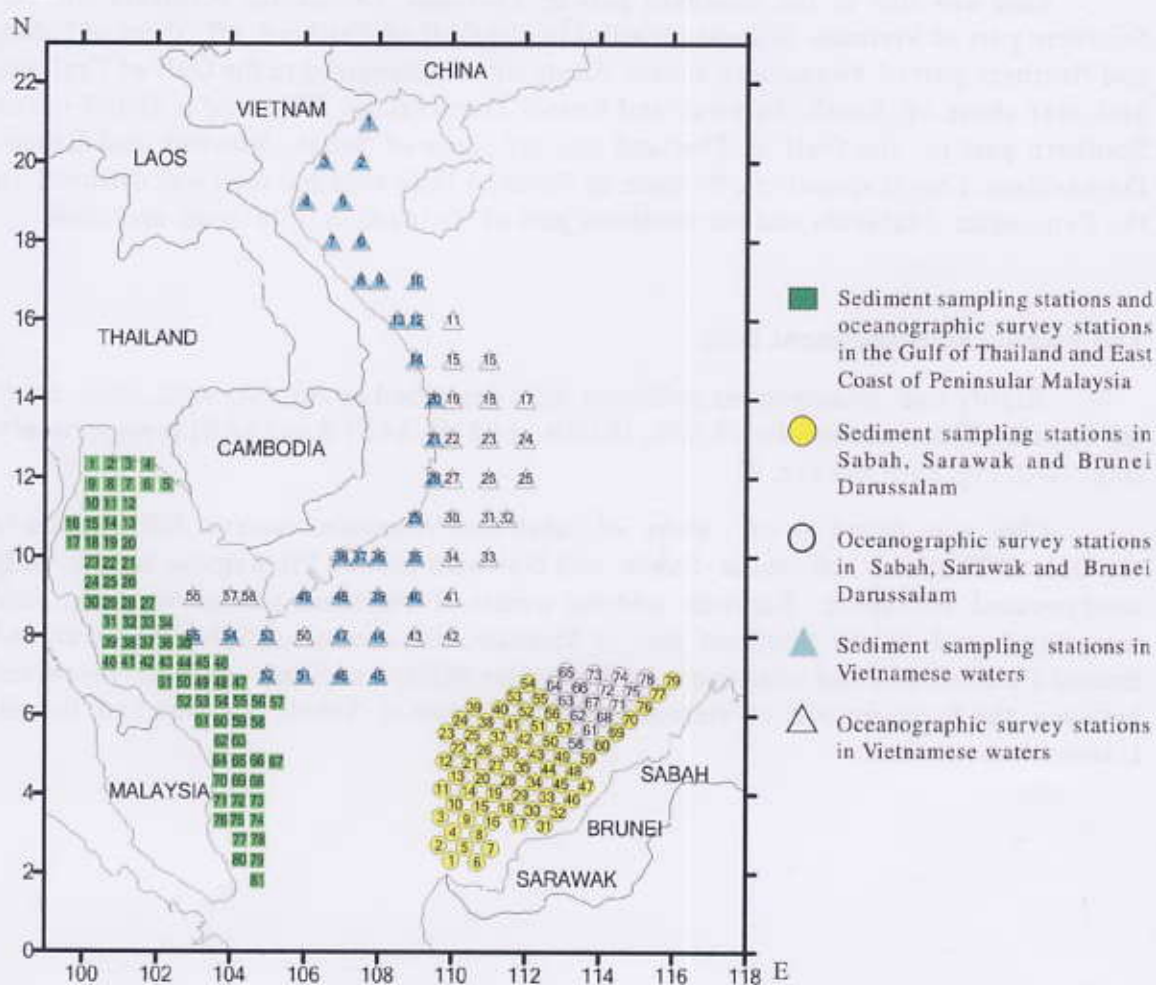


Fig. 5. The sampling station in the South China Sea.

4. Result

The size distribution

All the surface layer (2 cm of the upper layer) one hundred and seventy nine sampling stations were done (see Appendix I, II and III), all of the surface layer (2 cm of upper layer). The size distribution of the sediment of the survey areas were mainly *sand* and *silt* accounting for 26.29% and 24.57%, respectively of the sampling area. *Sandy silt*, *silty sand*, *clay*, *sand and shell* and *sand and stone* account for 22.86%, 16.57%, 6.86%, 2.29% and 0.57%, respectively. (see Fig. 6)

Sand was rich in the Southern part of Thailand, Peninsular Malaysia and the Southern part of Vietnam. *Silt* was plentiful in the Gulf of Thailand, off-shore of Sabah and Northern part of Vietnamese waters. *Sandy silt* was dispersed in the Gulf of Thailand and near shore of Sabah, Sarawak and Brunei Darussalam. *Silty sand* is found in the Southern part of the Gulf of Thailand and off-shore of Sabah, Sarawak and Brunei Darussalam. *Clay* is spread in off-shore of Sabah. A little *sand and shell* was diffused in the Peninsular Malaysia and the southern part of Vietnam. A little *sand and stone*

The homogenous sediment core

Eighty one homogenous sediment were described as *silt*, *silty sand*, *sand*, *sandy silt* and *clay*. These account for 39.51%, 16.05%, 14.81%, 14.81% and 14.81% respectively. (Fig. 7a-b, Fig. 8a-b and Fig. 9)

Clay was found in off-shore of Sabah and Vietnamese waters. *Silt* spreads in the Gulf of Thailand, off-shore Sabah and Northern part of Vietnamese waters. *Silty sand* covered off-shore Sarawak and the waters of Northern part of Vietnam. *Sand* was distributed in the Southern part of Vietnam, the coastal of Sabah, Sarawak and Brunei Darussalam, and near shore of Peninsular Malaysia. *Sandy silt* was dispersed between the Southern part of Vietnam and near shore of Sabah, Sarawak and Brunei Darussalam waters.

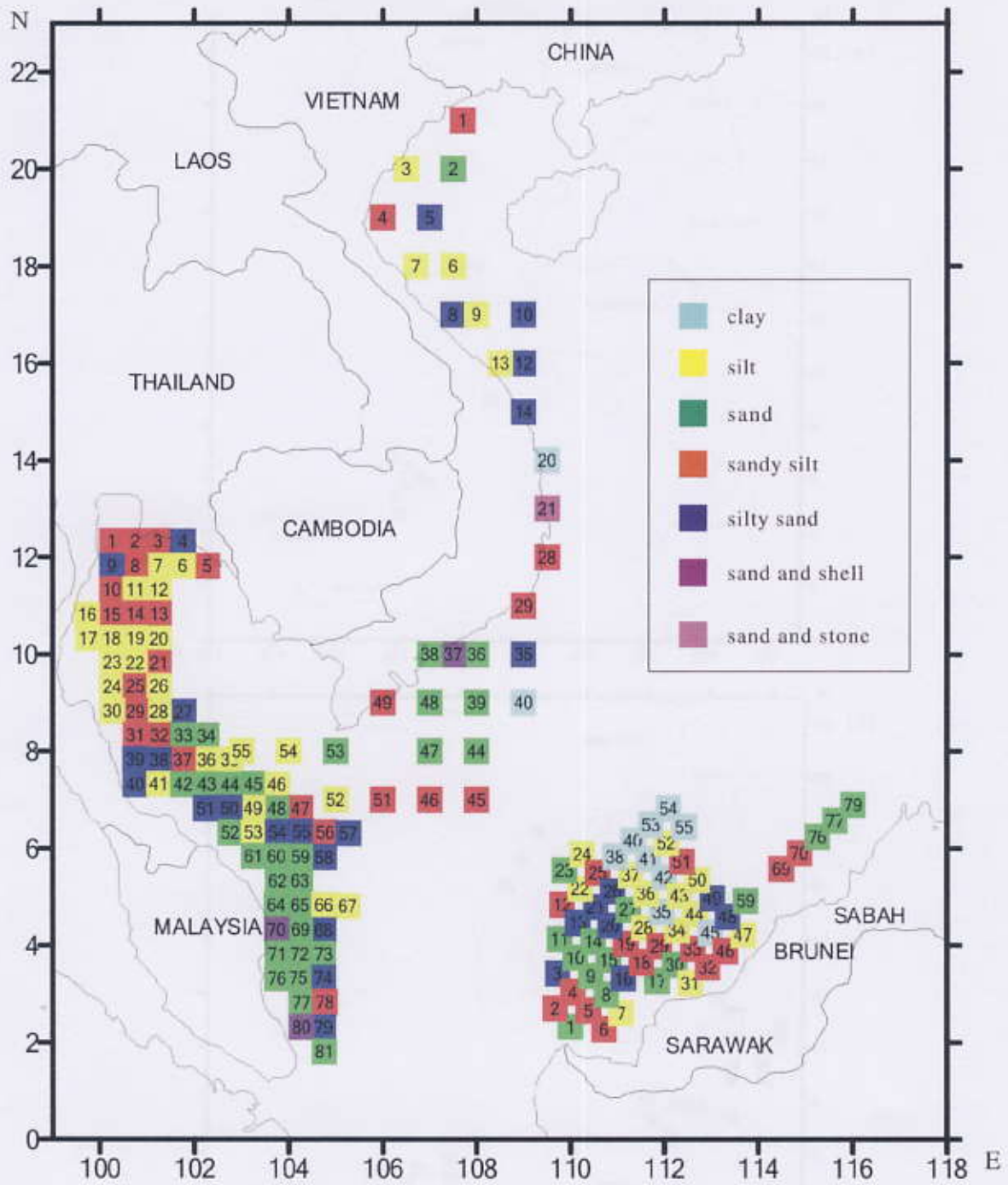


Fig. 6. Size distribution of bottom sediment in the South China Sea.

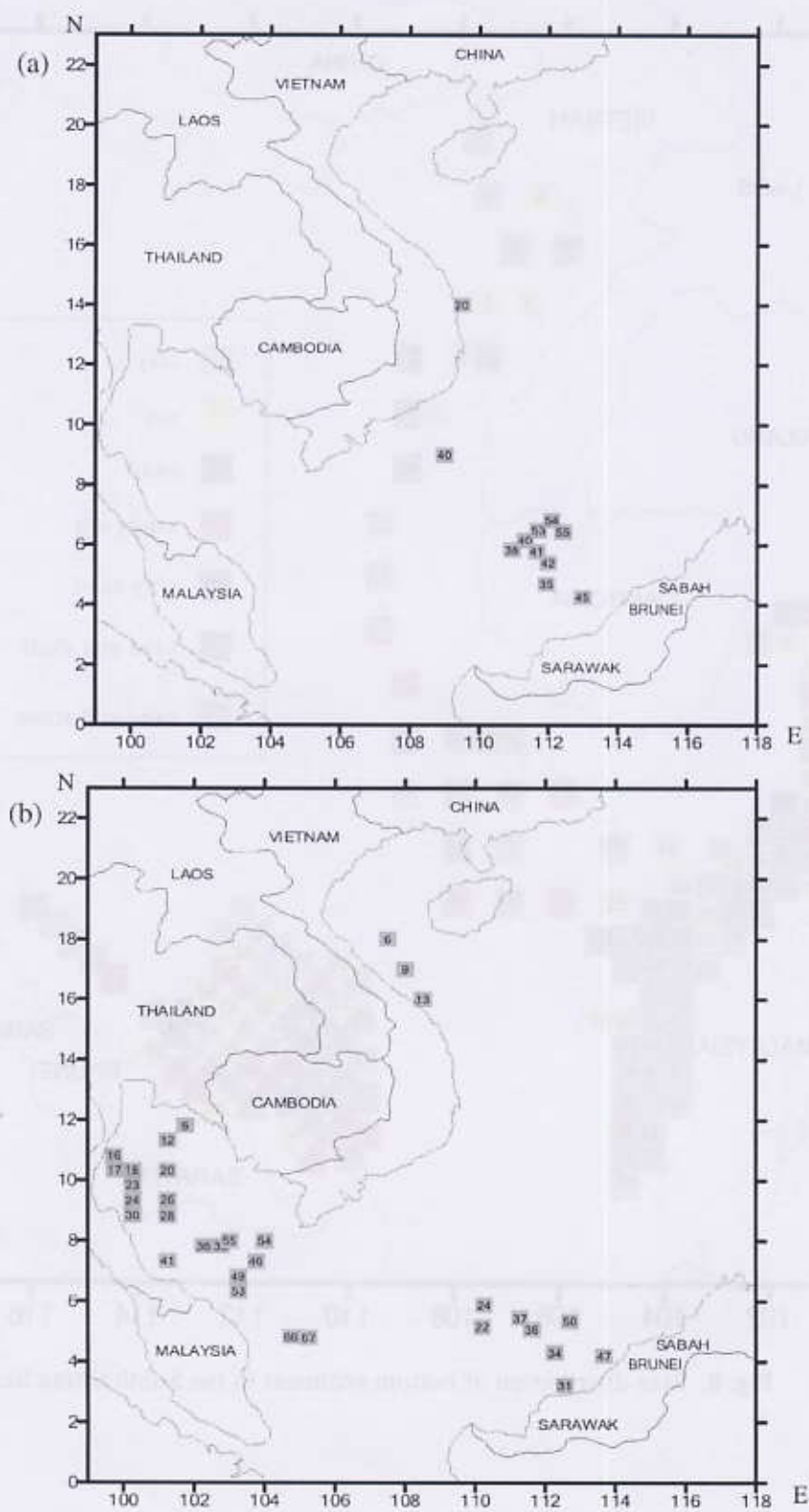


Fig. 7. The homogeneous sediment core: (a) clay, (b) sand

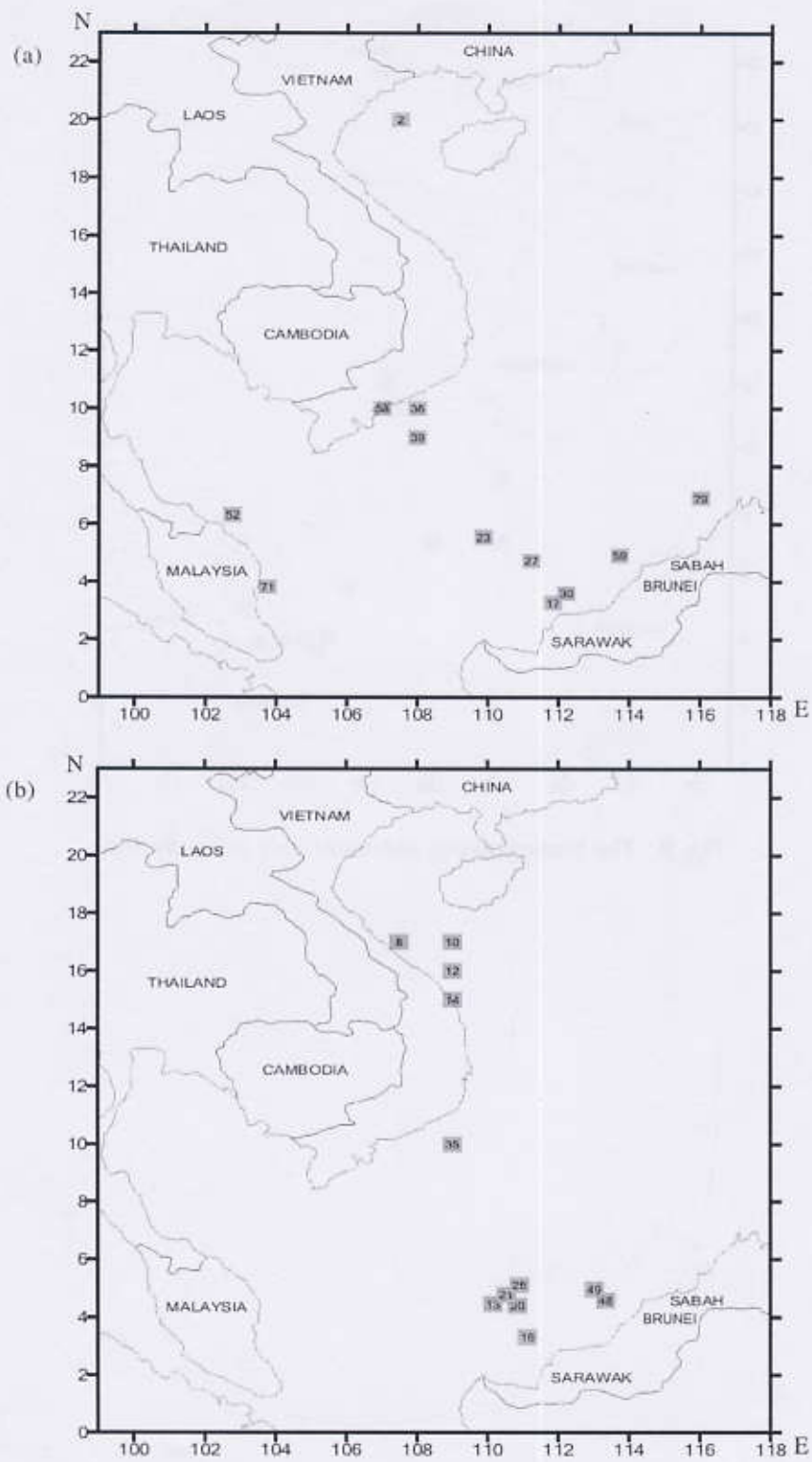


Fig. 8. The homogeneous sediment core : (a) silt, (b) silty sand

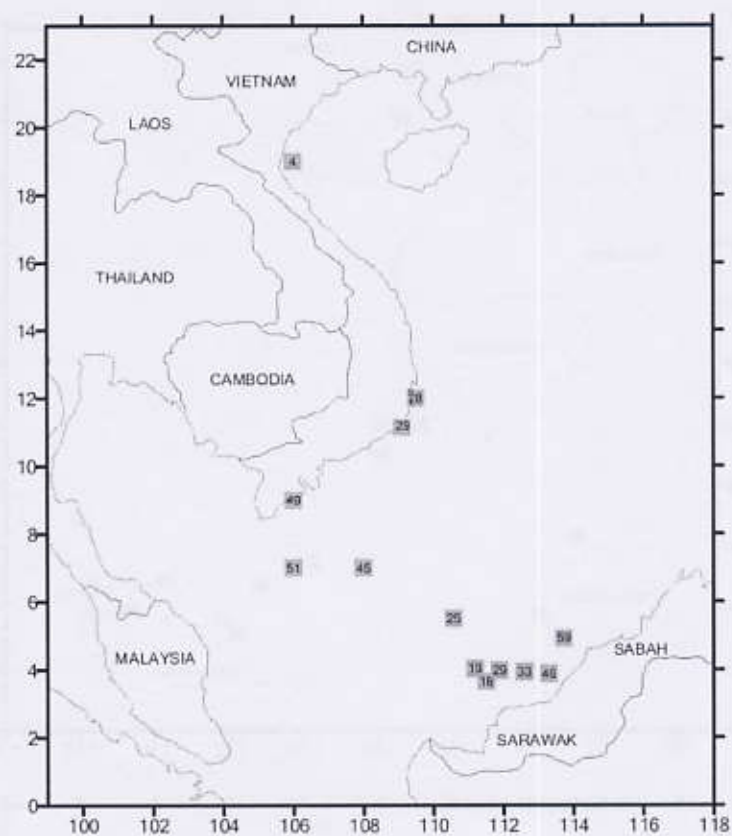


Fig. 9. The homogeneous sediment core of sandy silt.

5. Discussion

Clay was distributed from the shallow water depth around 100 m to the deep waters with a depth around 2,000 m. The particle size of clay is the smallest of all sediments (for sediment size refer to the Udden-Wentworth grain size scale) and so may be transported for long distance.

Silt is distributed from the shallow waters in the Gulf of Thailand to the deep waters where the depth is about 1,600 m (off-shore of Sarawak waters). Silty substrates was an important habitat for a diverse and vigorous biological community. It may be implied that in the Gulf of Thailand, Northern part of Vietnamese waters and near the shore of Sarawak waters are the great source of living animal and are therefore good fishing ground for demersal fish.

Sand was distributed from the shallow waters to the deep waters with depths of about 1000 m. The weathering of sandstone provide an import source of sand, normally, sand be seen in the open ocean. Sand was wide spread in the Southern part of the Gulf of Thailand and Peninsular Malaysia that be transport from the beach and nears-hore areas. Sand and silty sand substrates was suitable habitat for some kind of shell.

In future studies, the relationship of type of sediment and marine benthic fauna should be investigated.

6. Acknowledgement

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Appendix I. Sampling date, apparatus used, depth of obtained cores, and water depth in the Gulf of Thailand and East Coast of Peninsular Malaysia.

Date	Station	Apparatus	Core depth (cm)	Water Depth (m)	Date	Station	Apparatus	Core depth (cm)	Water Depth (m)
24 -Apr -96	1	gravity corer	13	31	8 -May -96	49	gravity corer	31	55
	2	gravity corer	16	29		50	gravity corer	49	51
	3	gravity corer	40	33		51	gravity corer	40	51
	4	gravity corer	16	28		52	grab	4	53
25 -Apr -96	5	gravity corer	13	36	9 -May -96	53	gravity corer	34	54
	6	gravity corer	22	52		54	gravity corer	22	63
	7	gravity corer	40	48		55	gravity corer	16	63
	8	gravity corer	16	40		56	gravity corer	31	59
26 -Apr -96	9	gravity corer	13	38	10 -May -96	57	gravity corer	22	60
	10	gravity corer	16	49		58	gravity corer	37	63
	11	gravity corer	13	53		59	gravity corer	28	63
	12	gravity corer	46	62		60	gravity corer	31	59
27 -Apr -96	13	gravity corer	25	64	12 -May -96	61	gravity corer	16	39
	14	gravity corer	22	61		62	gravity corer	25	60
	15	gravity corer	16	56		63	gravity corer	13	66
	16	gravity corer	40	50		64	gravity corer	19	61
28 -Apr -96	17	gravity corer	46	47	13 -May -96	65	gravity corer	19	65
	18	gravity corer	55	63		66	gravity corer	37	73
	19	gravity corer	10	65		67	gravity corer	22	77
	20	gravity corer	34	71		68	gravity corer	34	73
29 -Apr -96	21	gravity corer	31	71	14 -May -96	69	gravity corer	34	76
	22	gravity corer	46	60		70	grab	6	39
	23	gravity corer	61	34		71	grab	6	34
	24	gravity corer	55	30		72	gravity corer	16	56
1 -May -96	25	gravity corer	19	43	15 -May -96	73	gravity corer	25	73
	26	gravity corer	37	67		74	gravity corer	34	69
2 -May -96	27	gravity corer	22	78		75	gravity corer	22	53
	28	gravity corer	37	69	16 -May -96	76	gravity corer	10	28
1 -May -96	29	gravity corer	13	32		77	gravity corer	16	50
	30	gravity corer	58	25		78	gravity corer	22	67
2 -May -96	31	gravity corer	31	32		79	gravity corer	16	64
	32	gravity corer	46	55	17 -May -96	80	gravity corer	16	32
3 -May -96	33	gravity corer	31	73		81	gravity corer	37	55
	34	gravity corer	16	78					
	35	gravity corer	46	73					
4 -May -96	36	gravity corer	46	74					
	37	gravity corer	49	62					
	38	gravity corer	31	50					
	39	gravity corer	37	27					
6 -May -96	40	gravity corer	31	22					
	41	gravity corer	37	43					
	42	gravity corer	37	51					
	43	gravity corer	40	52					
7 -May -96	44	gravity corer	10	54					
	45	gravity corer	25	56					
	46	gravity corer	37	53					
	47	gravity corer	34	60					
	48	gravity corer	25	56					

Appendix II. Sampling date, apparatus used, depth of obtained cores, and water depth in the Sabah, Sarawak and Brnei Darussalam.

Date	Station	Apparatus	Core depth (cm)	Water Depth (m)
1-May-97	1	gravity core	31	37
	2	gravity core	39	55
	3	gravity core	34	81
	4	gravity core	38	67
2-May-97	5	gravity core	21	77
	6	gravity core	36	42
	7	gravity core	42	34
	8	gravity core	36	41
3-May-97	9	gravity core	28	65
	10	grab	15	87
	11	grab	15	101
	12	grab	15	119
4-May-97	13	grab	15	114
	14	grab	15	91
	15	grab	13	66
	16	grab	15	66
5-May-97	17	grab	10	30
	18	grab	6	48.1
	19	grab	12	71
	20	grab	15	91
6-May-97	21	grab	14	118
	22	grab	15	143
	23	grab	13	146
	24	grab	12	534
7-May-97	25	grab	13	203
	26	grab	13	124
	27	grab	12	95
	28	grab	14	80
8-May-97	29	grab	16	56
	30	grab	8	34
	31	gravity core	29	21
	32	gravity core	24	32
10-May-97	33	gravity core	38	51
	34	gravity core	34	73
	35	gravity core	37	88
	36	gravity core	35	110
11-May-97	37	gravity core	42	435
	38	gravity core	23	1045
	39	gravity core	*	1249
	40	gravity core	31	1128
12-May-97	41	gravity core	46	1285
	42	gravity core	36	137
	43	gravity core	37	105
	44	gravity core	41	89
13-May-97	45	gravity core	51	67
	46	gravity core	20	23
	47	gravity core	49	30

Date	Station	Apparatus	Core depth (cm)	Water Depth (m)
15-May-97	48	gravity core	39	78
	49	gravity core	39	107
	50	gravity core	46	757
	51	gravity core	29	196
16-May-97	52	gravity core	33	1524
	53	gravity core	52	1941
	54	gravity core	29	2030
	55	gravity core	37	1285
17-May-97	56	gravity core	*	1030
	57	gravity core	*	2348
	58	*	*	1574
	59	grab	12	96
18-May-97	60	grab	*	228
	61	*	*	2151
	62	*	*	2558
	63	*	*	1600
19-May-97	64	*	*	1345
	65	*	*	1593
	66	*	*	1885
	67	*	*	2816
20-May-97	68	*	*	1771
	69	grab	14	100
	70	grab	11	141
	71	*	*	2020
22-May-97	72	*	*	2865
	73	*	*	1841
	74	*	*	2893
	75	*	*	1774
23-May-97	76	grab	2	100
	77	grab	12	92
	78	*	*	1513
	79	grab	11	58

Note: * can not collect

