SEDIMENT DISPERSAL IN THE SOUTHERN BEAUFORT SEA

INTERIM REPORT DECEMBER 1974

BEAUFORT SEA PROJECT

SEDIMENT DISPERSAL IN THE SOUTHERN BEAUFORT SEA

Interim Report of Beaufort Sea Project Study F4

December, 1974

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BEAUFORT SEA PROJECT INTERIM REPORT

Project F-4 - Sediment Dispersal

In The Southern Beaufort Sea

I. Summary

Beaufort Sea sediments have been obtained by means of bottom grabbers and cores from ship-borne and helicopter-supported operations since 1970. A total of 1100 samples has been collected and all have been texturally analyzed. In this report the 98 grab samples obtained from CSS HUDSON in 1970 (Fig. 1) are described, and inferences on their texture, distribution and origin are given.

Both bathymetry and geography have been considered, but lacking is a fuller appreciation of ocean dynamics. As these companion studies progress on other projects, then can utilization of such data be realized for the sedimentary and coastal studies. What is known, however provides a reasonable framework for the sedimentary model in the Beaufort Sea. Sediment discharged from the Mackenzie River and is transported seaward to the north and east. A major sediment site is present in the Mackenzie Canyon and the adjacent shelf area to the east. Although coarser sediments on the eastern shelf suggest erosion, which may in part be true, they also represent relic sediments that are presently being obscured and buried by sediments being discharged from the Mackenzie River.

Other areas such as the coastal zone also appear to be sites of vigorous sedimentary processes, and may be providing considerable material to the sedimentary system. Although many of these areas have been sampled and the related sediments texturally analyzed, the data have not been examined to the point at which they could support this report. This will be forthcoming.

Studies on clay mineralogy, carbonate, total carbon and organic carbon have recently been ~~initiated~~. From various surveys, 244 representative samples have been selected and it is expected that the results of such studies will provide baseline data for projects affecting the environment of sedimentary deposition. Also, the sedimentary model may be further deduced and most certainly valuable data will be on hand in determining the main factors of the environment.

Additional studies are proposed, more for ancilliary projects than for the present one. Any environmental study is multi-disciplinary in scope and because much of man's future activity will be connected with the sea-floor, it is only reasonable to expect that the focus of a multi-disciplinary environmental study will be in the area of marine geology.

2. Introduction

This is a study of sediment dispersal based on a textural examination of the bottom sediments. It involves the origin, nature and distribution of these sediments as they occur on the sea bottom, and will include examination and analysis of additional sediments obtained by means of the piston cores. With reference to offshore exploratory drilling, the nature of the sea bottom is important for the following reasons: 1) to determine foundation strength of material, 2) the fate of sediment particles in connection with deposition and erosion particularly in the vicinity of artificial islands, and 3) to establish a data baseline in the event of an oil spill, 4) to make a reasonable estimate of the frequency of ice-scouring of the sea-floor.

3. Resume of Current State of Knowledge

At present, there is no comprehensive report on sediment dispersal in the southern Beaufort Sea, exclusive of the work of Carsola (1952), and that carried out by CSS HUDSON in 1970, which is reported here. Other related subjects deal with sea-floor scouring by ice-keels (Pelletier and Shearer, 1972), the nature and distribution of submarine pingos (Shearer et al, 1971), reports on molluscs (Wagner, 1972) and foraminifera (Vilks, 1973). All reports to date are preliminary in nature in that work is continuing in the various subjects and will be incorporated, in part, in the present study.

4. Study Area

The study area is restricted to the southeastern Beaufort Sea between Demarcation Point on the west and Cape Dalhousie on the east. Lying between longitudes 127°:00' and 141°:00', and latitudes 69°:30' and 72°:00', it extends a distance of approximately 150 kms offshore to depths of 1000m. Generally though, the seaward limit does not reach beyond the upper continental slope. Three major physiographic features are present (Fig. 2): 1) the continental shelf which grades gently toward the 100m isobath, the latter paralleling the coast line generally and conforming to the headward portion of the Mackenzie Canyon; the continental slope which falls fairly steeply from the shelf edge, and whose isobaths in the upper portion conform to both those of the continental shelf and Mackenzie Canyon; and the Mackenzie Canyon which transects the continental shelf and upper slope in a pronounced V-shaped pattern, with the headward portion immediately adjacent to the submarine portion of the Mackenzie River delta, and extending to the lower continental slope at a depth of nearly 1000m.

Minor but fairly significant morphological features are widespread and include ice-scour marks on the seabed, and pingos on certain areas of the shelf. Ice-scouring has been described (Pelletier and Shearer, 1972) as linear grooves produced by drifting ice moving along the sea floor. They occur in all depths of water to 80m or so, and some may be deeper but these would presumably be very old features. Both sonic and seismic records reveal the presence of ancient grooves, most of which have been infilled with sediments during the past several hundreds, if not several thousands, of years. The pingos occurring on the sea floor are ice-cored conical mounds up to 300 m in diameter at their base and rising to within 15m of sea surface where their narrow peaks are breached by expansive forces within the pingo itself. These features have been described earlier by Shearer et al (1971).

Along the low-lying coast of the mainland spits and bars associated with numerous offshore islands are present, and are extending their growth in an easterly direction. This latter phenomenon may be a response to longshore current action being influenced somewhat by the Coriollis effect which, at this latitude, is directed to the east.

5. Methods and Sources of Data

For the purpose of this interim report only the work carried out on the cruise of HUDSON 70 is reported here.

5.1 Field Techniques

Ninety-eight bottom samples were obtained by means of the VanVeen grab sampler. The locations of these samples are shown in Figure 1. These samples were stored aboard CSS HUDSON and transferred to laboratories at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia.

5.2 Experimental Techniques

In the laboratory sediment samples were processed for standard textural analysis by means of seiving and pipetting. All HUDSON 70 grab samples have been prepared for additional analyses to be undertaken for the identification of the major clay-mineral groups, and the determination of carbonate content, organic carbon and total carbon. In addition to these 98 samples, 146 samples (not shown in Fig. 1) obtained from other cruises and helicopter-supported operations have also been submitted for such mineralogical and chemical studies.

5.3 Data Analysis

Statistical operations using moment measures have been used to describe the textural data. Clastic ratios and relative entropy have also been calculated, and all results are given in Appendix A.

5.4 Phasing of the Work

In addition to the CSS HUDSON samples, approximately 1000 additional samples have been texturally analyzed but the data from this work have not been plotted or studied. Because these samples were obtained from several ships and helicopter-supported operations, it was necessary to have a common location map for all bottom samples collected in the Beaufort Sea. This map is presently being drawn by the Canadian Hydrographic Service at Victoria, British Columbia. The field work is virtually completed and a report could be issued on the basis of present information, but certain gaps in the sampling coverage will remain unless they can be eliminated in the 1975 field season.

All mineralogical studies should be completed by late spring, 1975, and all textural data on the bottom samples should be plotted by late summer, 1975. If additional sampling is undertaken, the analytical work can be carried out in early fall, 1975, and the results and analyses of all work plotted at that time. The final report will be completed by late 1975.

6. Results

All results of the study of sediment dispersal in the southern portion of the Beaufort Sea are shown in the sedimentological maps (Figs. 3-11) given in Appendix B of this report.

6.1 Sediment Types

The major textural sediment types based on the phi mean diameter are shown in Figure 3 (Appendix B). Clay-sized particles dominate and are found off the Mackenzie delta and over a large part of the continental shelf immediately adjacent on the east. A small area of fine sediments lies in the extreme northeastern area of the shelf and along the continental slope.

Silt is least abundant and occupies a narrow transecting zone of the shelf directly seaward off the east-central part of the Tuktoyaktuk Peninsula. This silt zone appears to have an inter-fingering relationship with the clay on the west and the sand on the east. Another occurrence of silt lies on the extreme eastern part of the shelf adjacent to Amunsden Gulf, and off the Mackenzie delta just east of Herschel Island.

Sand is the second-most major type of sediment. It occupies almost the entire area adjacent to the northwestern coast of Herschel Island. Although gravels are present in different areas, they are not a major portion of the sample to the extent where they can be separately defined as such on the basis of the phi-mean grain diameter of the sediment

6.2 Relative Proportions of the Major Sediment Types

From the table of textural data in Appendix A, it can be seen that clay is present in all samples and ranges between 19.3 and 82.85 per cent of the sample. The amount of the clay content is plotted in Fig. 4 (App. B), which shows a major area of deposition in the central portion of the Mackenzie Canyon and the shelf immediately to the east. When these values are contoured on the 10-percent isopleth, the varying contours run in a pattern that is parallel with the coast in the western part of the area, but is more-or-less of a transecting pattern in the west where it extends across the continental shelf. Here the clay content is 30 to 40 per cent less than in the western area, and its contours have an interfingering relationship with those that represent a greater clay content immediately adjacent on the west. The least amount of clay is found northwest of Herschel Island, and in small areas on the extreme eastern edge of the map.

Silt is the next most abundant textural class in most samples. In amounts it ranges between 8.79 and 68.46 per cent in these samples. As a dominant type areally, it is less widespread than either clay or sand. The percentage of silt content for each sample was plotted (Fig. 5, Appx. B), and, in general, the higher concentrations occur in the eastern areas of the shelf and the least in the Mackenzie Canyon and the immediately adjacent area of the central shelf to the east. A pattern similar to that for clay is revealed in the orientation of the isopleths. They are more or less parallel with the coast in the west, and somewhat transect the shelf in the east.

Sand is also present in all samples but in generally much smaller amounts than either the silt or clay, except where it is the dominating constituent in the eastern part of the shelf. It ranges in amounts from .03 to 64.70 per cent for these samples. The sand content for each sample is plotted in Figure 6 (App. B). The higher concentrations are shown in the eastern area of the shelf, and a portion of the shelf west of Herschel Island. An almost east-west orientation of the isopleths occurs in the central area of the map, but this changes to a pattern that somewhat transects the shelf to the east.

Gravel is the least significant in terms of percentage content per sample. It ranges from 0.01 to 38.30 percent for these samples, with many samples (about 15%) containing no gravel whatsoever. The gravel content for each sample was plotted in Figure 7 (App. B). It is clear from this map that, except for a few localities in the east and the general area northwest of Herschel Island, gravel is a minor constituent of the sediments beneath the southern Beaufort Sea.

6.3 Sorting

Values for sorting, based on phi standard deviation were plotted in Figure 8, App. B. No sample showed very good or excellent sorting. Areas of fair to good sorting lie in the central portion directly off the Mackenzie delta, along the entire edge of the continental shelf, and in the coastal zone east of Herschel Island. Poor sorting is characteristic of the sediments occupying all the eastern half of the shelf and again in the area northwest of Herschel Island.

Relative entropy as defined by Pelto, (1954) was utilized in a sedimentological study in the Bay of Fundy, Pelletier (1974). This parameter is realistic because it uses all the textural data obtained in the analysis and yet is independent of the mean. Values of this sorting index are plotted in Figure 9 (App. B) and very easily show the areas of good and fair sorting. Good sorting in the region lying off the Mackenzie Delta partly describes the fine grained sediments that appear to be the dominant textural class discharged by the Mackenzie River. As this material moves easterly over the relic sands occupying the eastern Beaufort shelf, it mixes with the sand and increases the sorting range. On the west end of the Beaufort Shelf, the poor sorting (high relative entropy) is the result of ice-rafting of coarser sediments into finer sediments presumably in transit, and some possibly in residence, from deltas and sea coasts lying to the west.

6.4 Clastic Textural Ratios

A plot of the sand, silt and clay contents for each sample was made and is shown in a ternary diagram (Fig. 10, App. B). The gravel portion was omitted, as it appeared to be due to ice-rafting. In Fig. 9, two distinct patterns emerge: 1) a plot of the samples from the eastern and western portions of the shelf, which show in the central part of the diagram and 2) a plot of the samples from the Mackenzie Canyon and the adjacent area of the shelf to the east.

6.5 The Silt/Clay Ratio

This parameter is used because of its sensitive response to dynamic conditions particularly in the absence of coarser sediments (Pelletier, 1973). Values of the silt/clay ratio were plotted in Figure 11 (App. B). Isopleths show the pattern which lies parallel to shore in the area of the Mackenzie Canyon and adjacent central shelf. This pattern describes the area of very low silt/clay ratios. In the eastern part of the study area, the isopleths transect the shelf and the silt/clay ratios here are high. The ratios are also high west of Herschel Island and along the coastal zone exclusive of the Mackenzie delta.

7. Discussion

The sedimentological maps depict a dispersal pattern that is most unlike the classical concept of sediment texture decreasing with remoteness from the source. In the southern Beaufort Sea, the major source of sediments is the discharge from the Mackenzie River system. Satellite photographs released recently show the sediment plume discharging from the delta area and flowing toward the east under the influence of the Coriollis force. This immediate area of sediment discharge is characterized by fine sedimentary textures which becomes progressively coarser to the east (Fig. 3, App. B). Apparently the area of the Mackenzie Canyon and the central shelf to the east represent sites of sediment deposition, particularly in the very fine sizes.

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In the eastern portion of the map, coarser sediments occupy most of the sea floor. It is conceivable that some of this material is undergoing erosion by the agency of bottom currents. The low silt/clay ratios in the Mackenzie Canyon and central shelf, together with the higher ratios in sediments of the eastern shelf support the idea of a depositional site in the former area, and an erosional site in the latter. In this latter case, it appears that relict coarser surficial sediments are mixed with fine material from the Mackenzie River, but undergo scouring and the eroded sediments are transported westward to the major depositional site in the Mackenzie Canyon and central shelf. This would explain the classical dispersal pattern of coarse to fine, but current-meter observations are needed to confirm this suggestion.

In the area west of Herschel Island, the bottom sediments appear to be related to the action of drifting ice. Very poor sediment sorting rather supports this idea. Such deposits could originate from the large fields of ice which have wedged against Herschel Island. The coastal zone exclusive of the delta region, however, appears to be the site of coarser sedimentation and perhaps more vigorous current action.

8. Conclusions

8.1 Except for the area northwest of Herschel Island, sediments in the Beaufort Sea are mainly fine-grained and consist of clay and silt in the western and central areas, and sand in the eastern part. This dispersal pattern is partly a result of the fine-grained sediment discharge from the Mackenzie River, and partly due to sedimentation of fine particles over a relict surficial sand that is presumably intermittently eroded by westward-moving bottom currents. Thus the western shelf appears to serve alternately as a depositional and erosional site.

9. Implications and Recommendations

9.1 Scientifically the Beaufort Sea represents a sedimentary model of relic sediments being obscured by encroaching sedimentation from the discharge of a major fluvial system. The role of sea level has not been discussed but a preliminary support study of the cores indicates that recent submergence has been a dominant factor in creating a site of quiet deposition near the delta front. Additional textural relationships regarding submarine physiography, hydrodynamic vigour, currents, ice and remoteness from shore and other sedimentary source areas must be established. The sub-bottom studies of the unconsolidated material by means of sonic and seismic investigations must be made in order to determine sediment thickness and its origin.

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9.2 Sediment thickness is a major concern in resources development of the sub-seabed, mainly in developing an engineering background for the emplacement of installations on the sea floor. The mineralogic studies are important as they may provide information on the routes of sedimentary transport, as well as on the fate of the sediments upon entry into the Beaufort Sea environment.

9.3 The study has not progressed sufficiently to recommend judgement views at this time.

10. Needs for Further Study

10.1 Identification of existing gaps in knowledge. This topic is too open-ended to discuss in detail. However the following studies are urgently needed: 1) sediment thickness, 2) core analyses of the sub-bottom, 2) sonic and seismic studies to establish the post-Tertiary stratigraphy, 3) completion of the bottom-sampling survey, 4) completion of the mineralogic and geochemical analyses, 5) oceanographic information particularly that dealing with the dynamic aspects such as air-sea interface, tides, waves and currents. (The latter two may be most significant when considering sediment transport), 6) flow studies on the Mackenzie River particularly to determine the amount and kind of sedimentary material entering the Beaufort Sea, 7) additional coastal studies particularly those related to the sediment budget, 8) detailed bathymetric studies on ice-scour features and their relationship to sedimentation, 9) shallow drilling to bedrock in order to obtain information on the unconsolidated sediments, and (10) many other related programs which should emerge as studies from one field become known to workers in other fields while on this project.

10.2 Proposals for Additional Studies

Many proposals are implied in 10.1 above. However for Project F-4, the main proposal involves additional sampling by means of ship-supported or helicopter supported operations, and to observe the sea bottom from direct observations in submersibles. The use of the submersible should be an important arm of Arctic marine research, and should be employed whenever possible in order to develop sufficient skill and knowledge in such operations.

Much of the present scientific information on the Beaufort Sea is to be published in the format of an Atlas. As an additional proposal the writer would be most grateful if he could receive such material from other workers involved in the Beaufort Sea Project. Although the Atlas is not part of the project, it will serve as an excellent medium to disseminate knowledge on the various phenomena of the region, in a succinct, interesting and useful format for the educator and the engineer, and for those interested in environmental aspects of this part of the Canadian Arctic, particularly those involved in the development of our natural resources.

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APPENDIX A - TABLE OF TEXTURAL DATA

FOR HUDSON 70 BEAUFORT SEA SEDIMENTS

STATION NUMBER	WATER DEPTH (m)	GRAVEL %	SAND %	SILT %	CLAY %	MEAN %	STANDARD DEV Ø	RELATIVE ENTROPY Hr%
340	66	1.19	2.30	28.78	67.73	8.17	2.14	53.01
341	177	0.06	1.07	26.70	72.18	8.50	1.43	47.99
342	49	0.00	1.09	40.41	58.50	8.01	1.75	54.45
343	131	0.20	9.08	41.94	48.77	7.38	2.18	62.57
344	139	0.10	1.81	39.83	58.26	7.91	1.87	56.51
345	740	0.00	0.22	25.14	74.64	8.66	1.22	43.70
346	539	0.00	0.27	26.06	73.67	8.61	1.28	45.02
347	390	0.24	0.33	25.18	74.26	8.63	1.38	42.91
348	295	0.05	0.18	22.67	77.10	8.72	1.24	41.91
349	250	0.15	0.16	22.65	77.04	8.75	1.19	48.58
350	198	0.22	0.35	26.72	72.71	8.54	1.45	45.62
351	200	0.01	1.17	28.89	69.94	8.44	1.51	48.68
352	60	38.30	31.67	10.73	19.30	1.46	5.05	88.29
354	610	0.00	0.23	26.19	73.58	8.61	1.30	44.11
355	451	0.00	0.27	25.33	74.40	8.65	1.29	43.59
356	211	0.27	3.54	25.35	70.84	8.35	1.83	49.83
357	44	28.25	32.64	15.95	23.15	2.76	4.63	87.42
358	25	3.89	34.03	33.37	28.71	5.15	3.45	82.12
361	1455	0.01	0.26	23.78	75.95	8.69	1.20	42.82
362	537	0.18	0.30	26.12	73.41	8.58	1.39	45.29
363	62	19.60	35.37	12.38	32.65	3.69	4.97	85.68
364	51	9.23	55.89	12.67	22.22	3.64	3.76	78.50
365	26	6.64	18.83	37.95	36.57	5.94	3.51	72.23
366	33	0.02	0.11	28.93	70.94	8.52	1.31	47.13
367	42	0.21	0.74	33.56	65.49	8.28	1.61	51.68
368	100	0.02	0.96	45.96	53.06	7.84	1.73	56.79
369	801	0.31	4.60	18.92	76.16	8.51	1.80	46.29
370	421	0.07	0.19	30.80	68.94	8.46	1.38	47.98
371	240	29.44	2.81	15.71	52.03	4.39	6.49	58.07
372	98	0.10	0.83	22.20	76.86	8.65	1.42	43.20
373	60	0.03	0.08	37.22	62.66	8.40	1.21	47.63
374	44	0.02	0.10	38.22	61.66	8.37	1.22	49.92
375	24	0.00	0.09	29.35	70.56	8.59	1.17	45.20
376	846	0.02	0.47	23.51	76.00	8.69	1.28	42.79
377	322	0.02	2.91	35.55	61.54	8.04	1.83	55.16
378	47	0.04	0.31	18.54	81.11	8.85	1.13	38.77
379	38	0.06	0.18	23.41	76.36	8.74	1.15	41.38
380	27	0.00	0.03	25.55	74.42	8.70	1.09	42.53
381	18	0.01	0.04	31.99	67.97	8.49	1.26	46.53
383	1390	0.00	0.22	27.26	72.52	8.59	1.28	44.95

STATION NUMBER	WATER DEPTH (m)	GRAVEL %	SAND %	SILT %	CLAY %	MEAN %	STANDARD DEV Ø	RELATIVE ENTROPY Hr%
384	700	0.00	0.09	29.53	70.38	8.49	1.39	46.91
385	57	0.05	0.23	19.57	80.16	8.82	1.18	39.19
386	46	0.00	0.07	23.06	76.87	8.77	1.17	40.30
387	28	0.00	0.03	32.67	67.30	8.52	1.21	45.95
388	864	4.31	2.13	17.23	76.33	8.21	2.88	47.07
389	495	0.08	0.14	31.45	68.32	8.42	1.46	48.96
390	87	0.17	1.98	25.95	71.89	8.43	1.64	48.79
391	62	0.00	0.15	19.17	80.67	8.84	1.05	38.80
392	55	0.04	0.91	17.35	81.71	8.84	1.18	39.05
393	37	0.01	0.92	22.82	76.25	8.70	1.24	42.60
394	58	1.59	13.09	14.80	70.53	7.90	2.70	52.24
395	62	0.02	0.39	16.74	82.85	8.87	1.11	38.24
396	45	0.05	10.74	16.64	72.57	8.24	2.08	48.86
398	457	0.00	0.06	28.68	71.27	8.54	1.33	45.56
399	146	0.18	8.37	27.66	63.79	7.90	2.26	57.70
400	73	0.01	0.15	22.51	77.33	8.71	1.21	51.06
401	25	0.02	9.96	20.77	69.25	8.15	2.10	51.84
402	31	0.58	64.70	8.79	25.93	4.07	3.49	53.69
403	17	0.10	1.48	47.44	50.98	7.90	1.64	56.58
404	19	0.15	16.11	27.54	56.20	7.47	2.61	58.53
405	16	0.02	0.06	43.48	56.44	8.16	1.37	51.32
406	30	0.00	0.05	32.88	67.07	8.50	1.23	46.61
407	850	0.00	0.16	27.33	72.51	8.57	1.31	45.52
408	277	0.07	0.37	29.98	69.58	8.43	1.52	48.23
409	85	0.01	0.53	31.14	68.32	8.30	1.66	50.11
410	70	0.04	2.14	28.58	69.24	8.28	1.79	50.62
411	62	0.06	0.35	22.02	77.56	8.69	1.30	43.03
412	42	0.13	23.33	19.30	57.24	7.15	2.93	61.16
413	699	0.01	0.15	33.28	66.55	8.41	1.38	47.87
414	346	0.00	0.05	55.80	44.14	7.05	2.18	53.67
415	80	0.20	23.89	34.73	41.18	6.40	2.80	66.26
416	873	0.21	20.55	21.77	57.46	7.26	2.78	60.20
418	32	0.15	27.39	35.88	36.59	6.15	2.77	69.09
419	63	0.04	6.18	28.00	65.78	8.07	2.04	54.33
420	36	1.35	31.80	36.17	30.68	5.73	3.13	72.84
421	29	0.84	74.49	14.75	9.92	3.59	2.33	54.86
422	16	0.09	2.61	68.46	28.83	6.46	2.03	61.84
423	22	1.04	3.03	47.27	48.66	7.54	2.13	61.88
424	580	0.02	0.29	30.02	69.67	8.50	1.36	47.14
425	97	0.23	44.51	19.51	35.75	5.63	3.14	65.20

STATION NUMBER	WATER DEPTH (m)	GRAVEL %	SAND %	SILT %	CLAY %	MEAN %	STANDARD DEV Ø	RELATIVE ENTROPY Jr%
426	62	0.35	14.73	26.02	58.90	7.49	2.59	61.13
427	54	2.76	14.06	30.57	52.61	7.12	3.01	66.69
428	32	0.05	43.96	20.99	35.00	5.72	3.12	60.67
429	25	0.30	22.06	27.51	50.12	7.13	2.66	64.45
430	18	0.36	11.63	40.23	47.78	7.83	2.31	64.02
431	300	0.00	0.20	33.93	65.87	8.33	1.48	49.97
432	62	6.20	32.27	26.75	34.78	5.37	3.72	73.47
433	44	0.17	1.68	50.54	47.60	7.50	1.97	60.42
434	32	0.29	2.36	55.11	42.23	7.26	2.04	62.27
435	29	0.43	2.10	60.48	36.99	6.86	2.20	70.89
436	69	0.79	2.78	42.70	53.73	7.63	2.19	60.61
437	475	0.93	11.61	58.31	29.15	6.20	2.40	63.67
438	45	0.25	39.14	32.83	27.78	5.63	2.70	69.97
439	40	10.07	7.21	41.64	41.08	6.31	3.83	72.84
440	16	0.10	1.15	37.41	61.34	9.26	1.50	51.04
441	16	0.04	0.14	47.00	52.82	8.06	1.42	52.84
442	225	0.04	0.14	32.21	67.61	8.44	1.37	47.82
444	106	0.26	0.23	40.91	58.60	8.07	1.66	54.34

LIST OF ILLUSTRATIONS

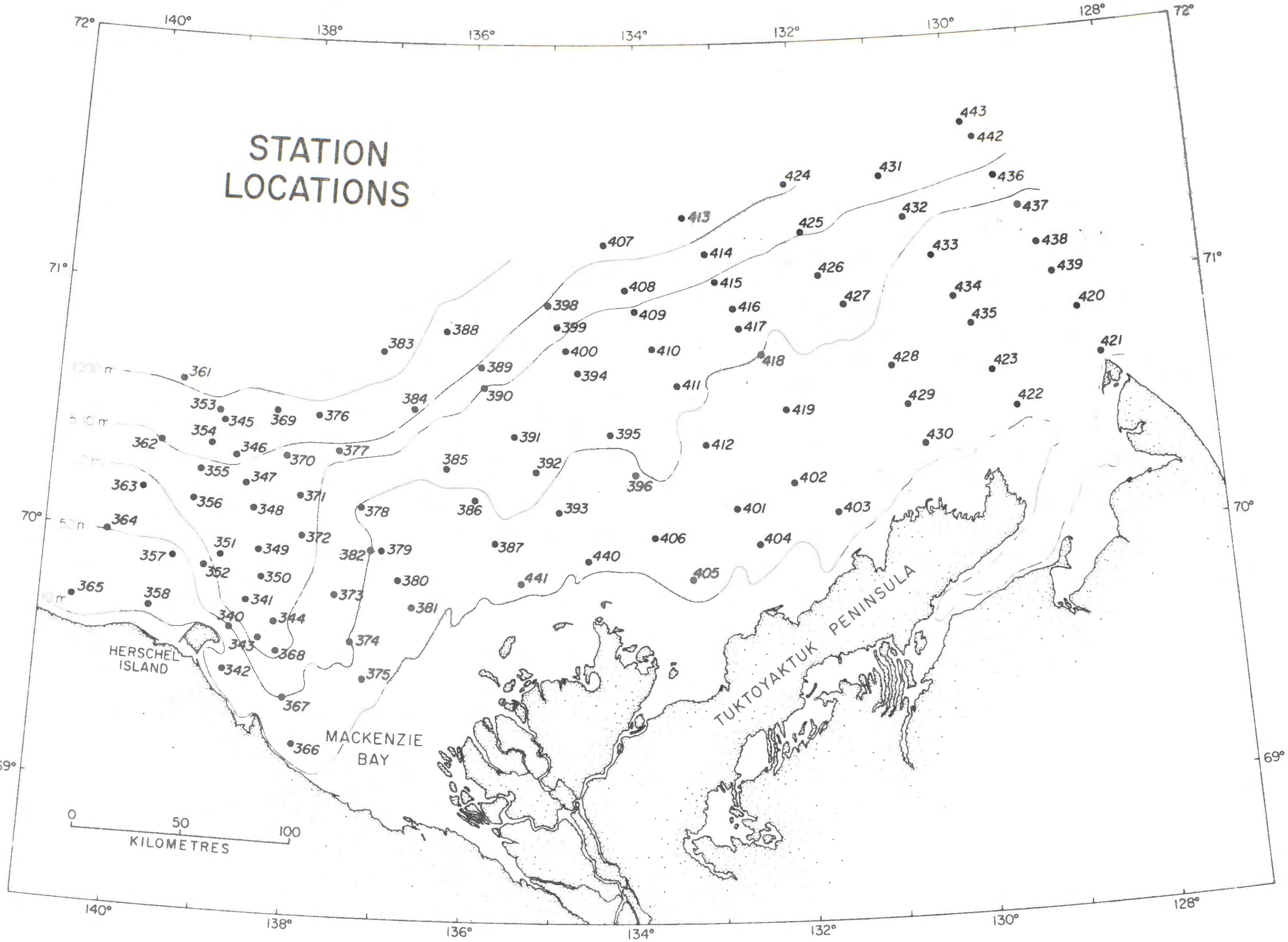

Fig. 1 Location of HUDSON 70 bottom-sampling stations.

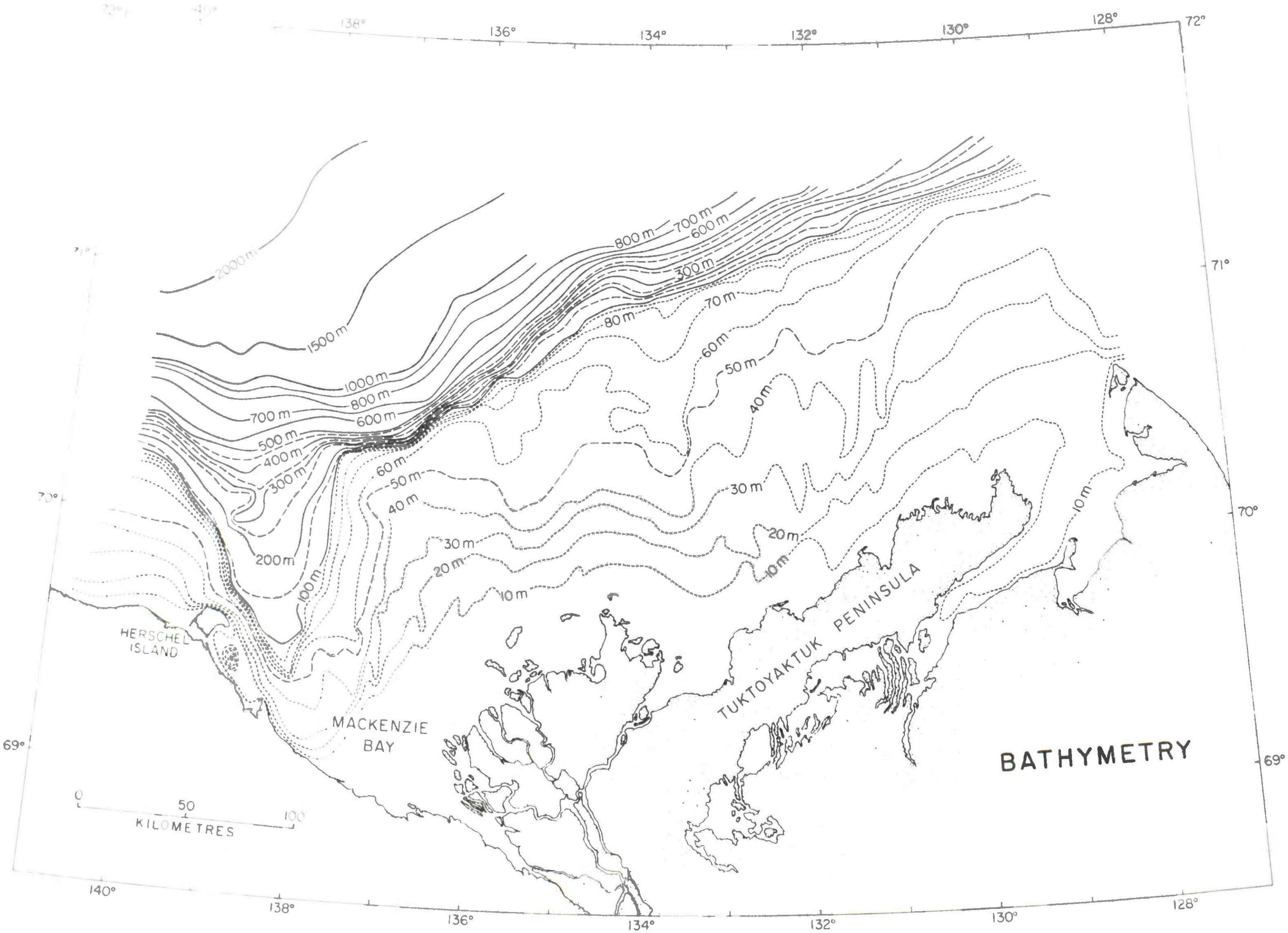

Fig. 2 Bathymetric map shows continental shelf and slope and the Mackenzie Canyon.

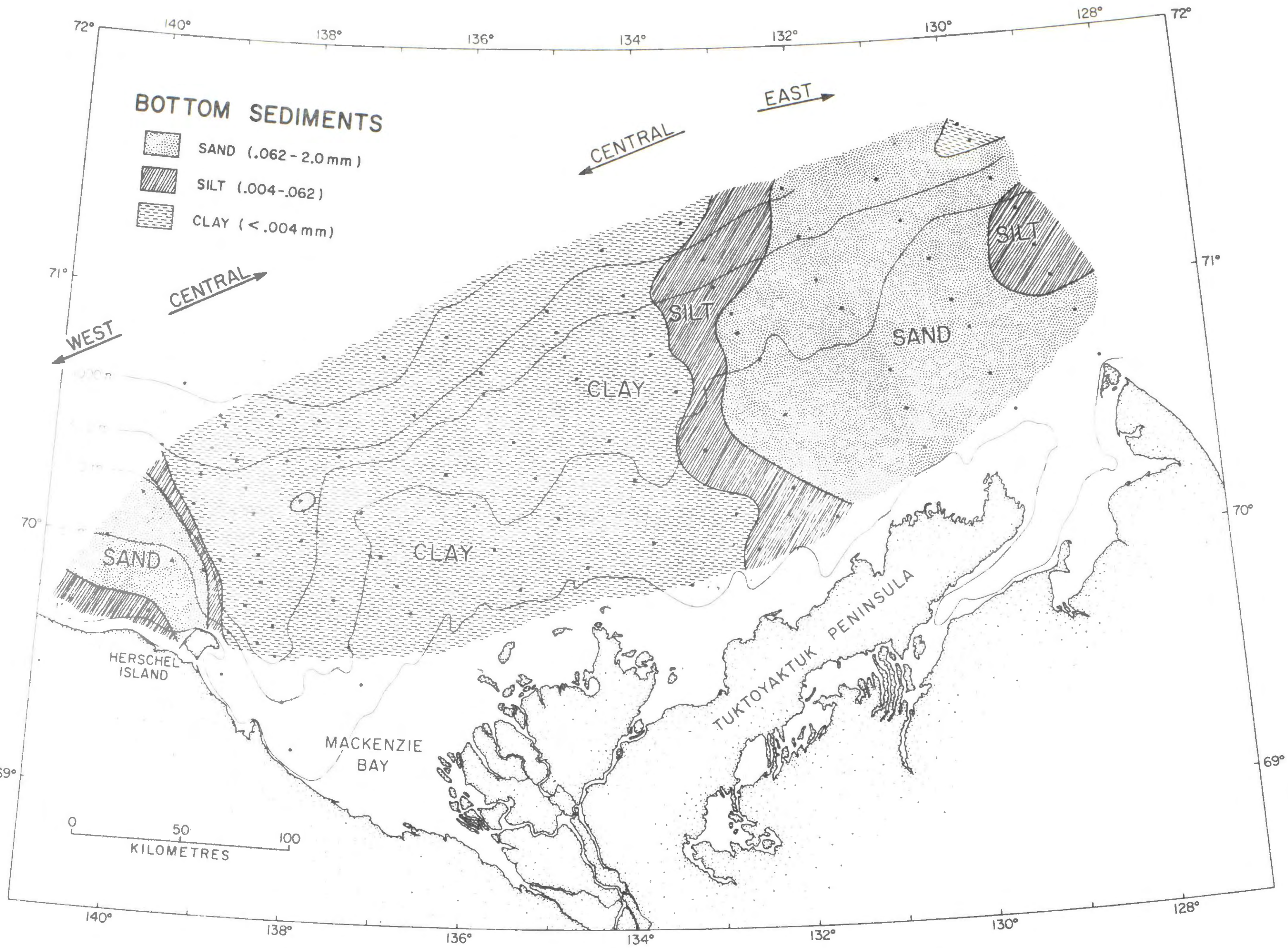

Fig. 3 Major sediment types based on the phi mean diameter of the sample.

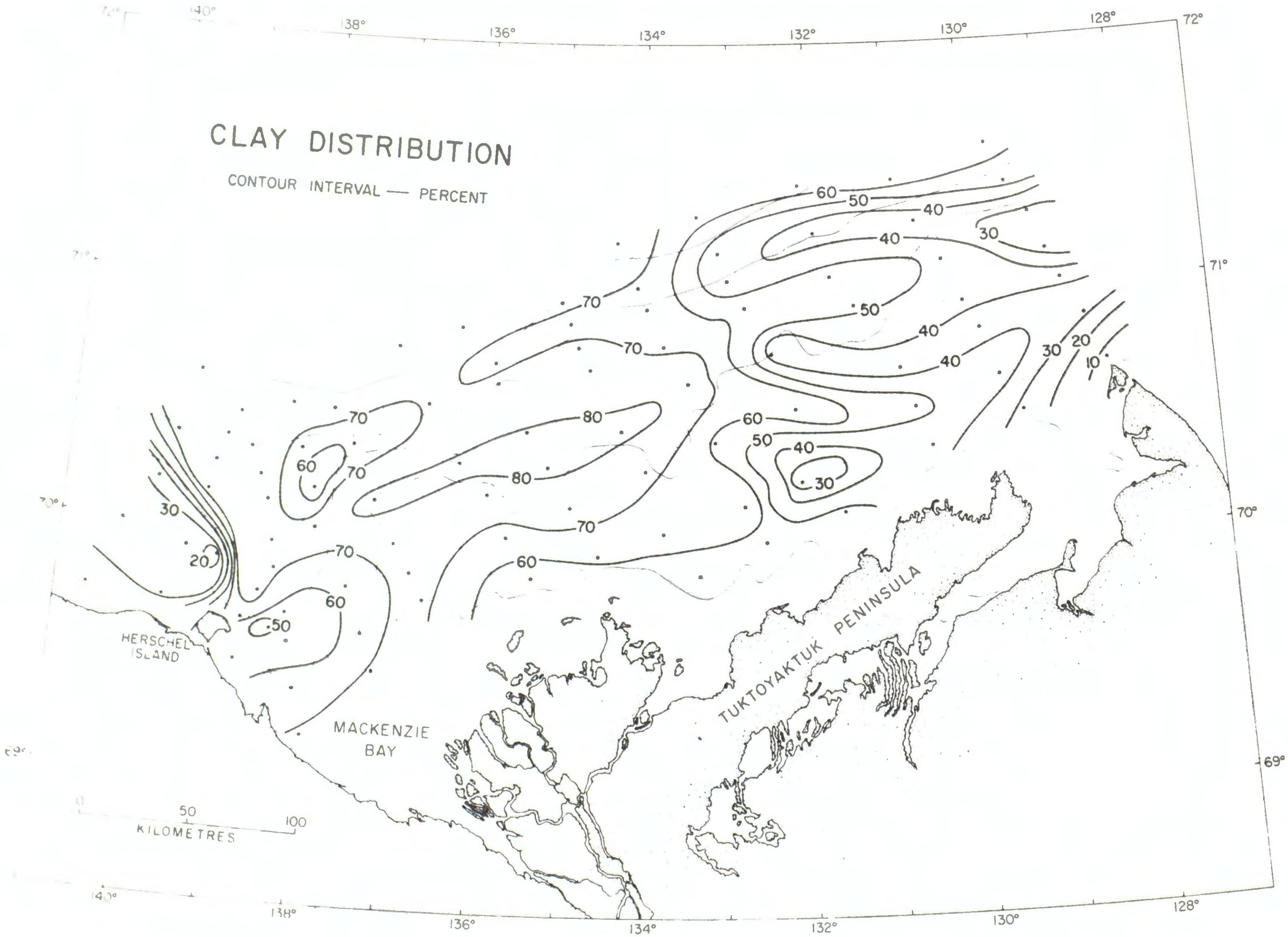

Fig. 4 Distribution of clay reveals a major despositional site north and northeast from Mackenzie Bay.

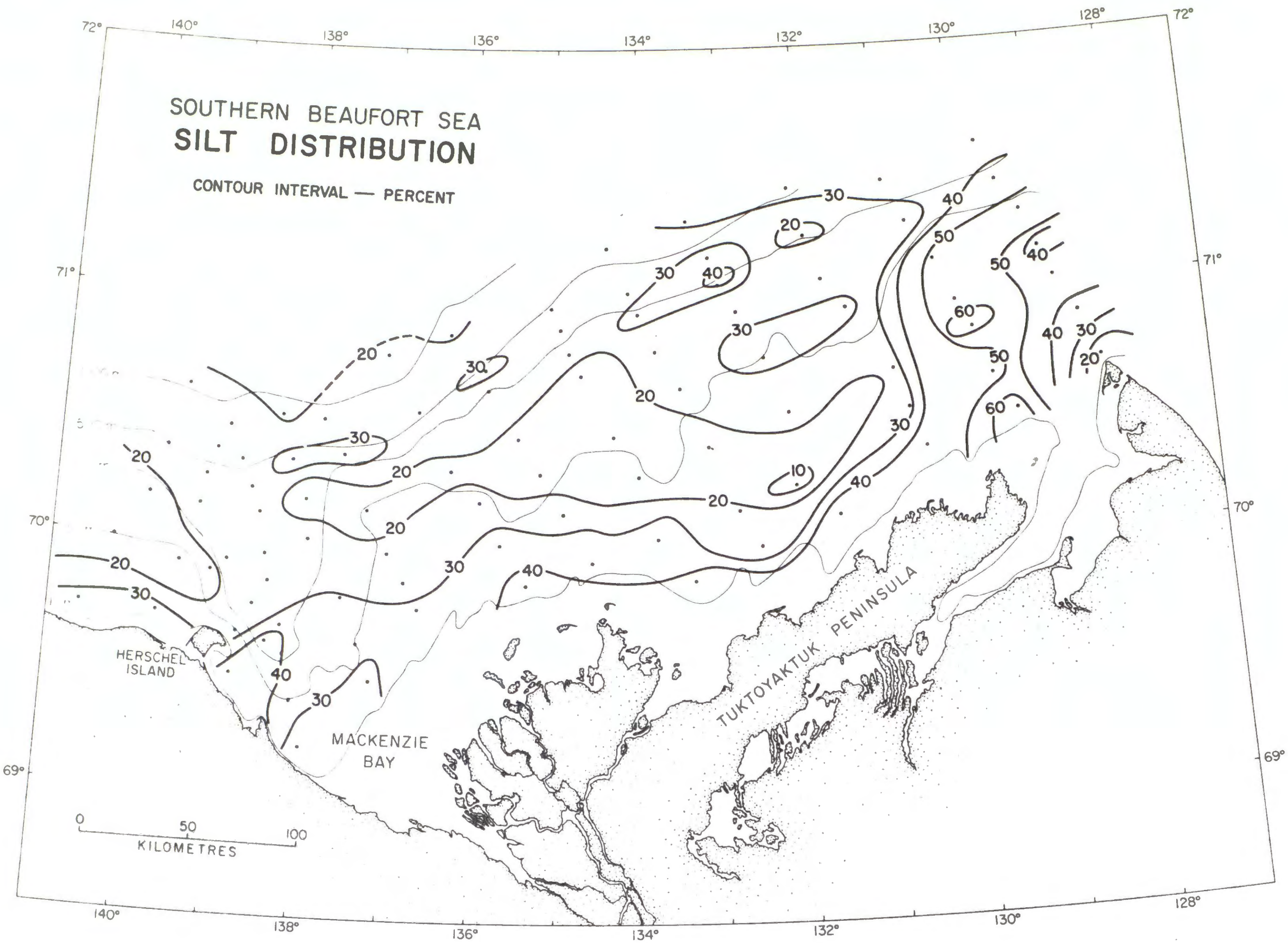

Fig. 5 Distribution of the silt content shows a similar orientation of isopleths as in the case of clay distribution (Fig. 4).

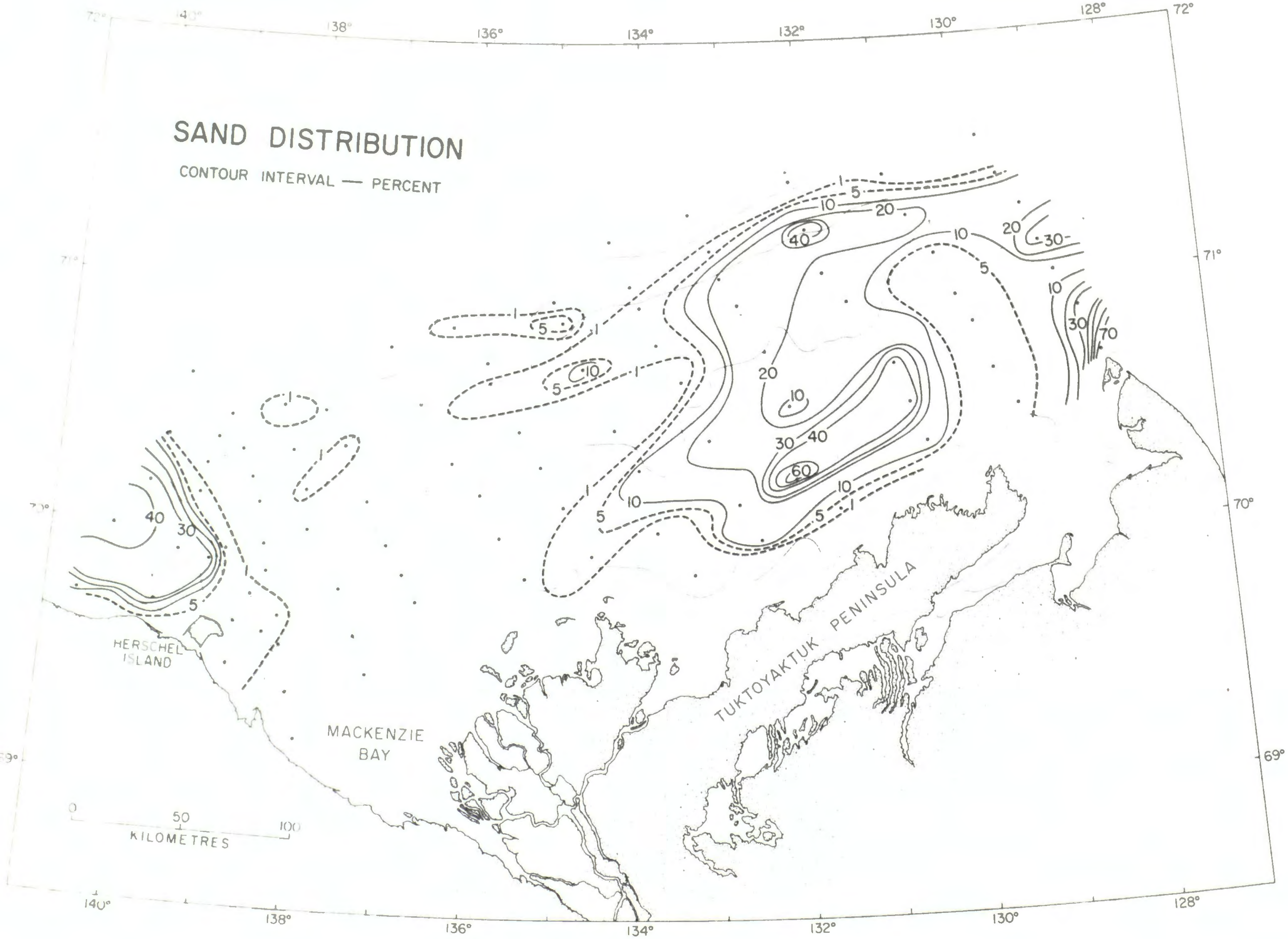

Fig. 6 Distribution of sand content in the bottom grabs shows increasing importance of sand on the eastern part of shelf, and west of Herschel Island.

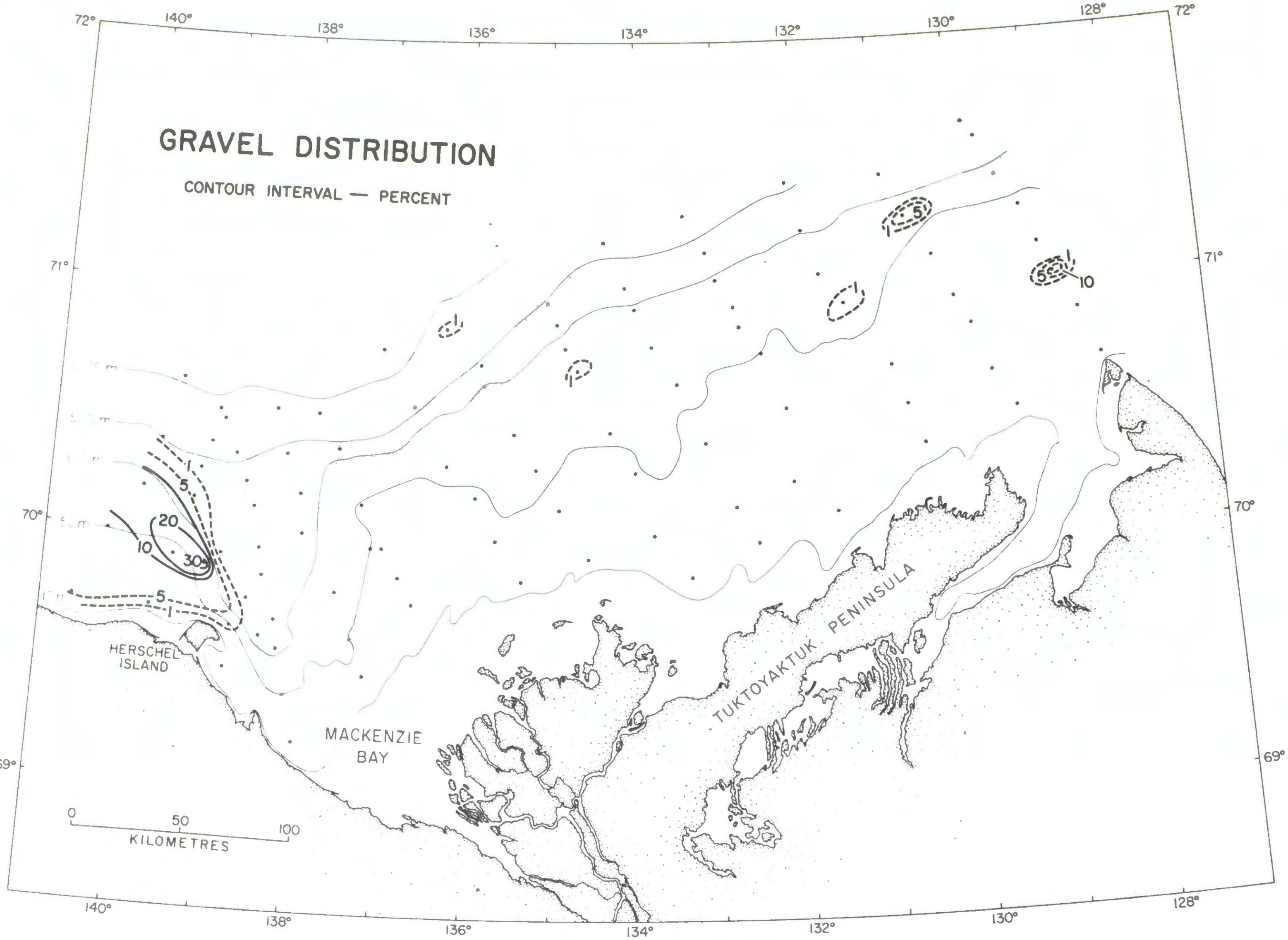

Fig. 7 Distribution of the gravel content per sample shows the virtual absence in nearly all areas of the shelf exclusive for that west of Herschel Island, and also on the extreme east. Gravel is absent in the Mackenzie Canyon.

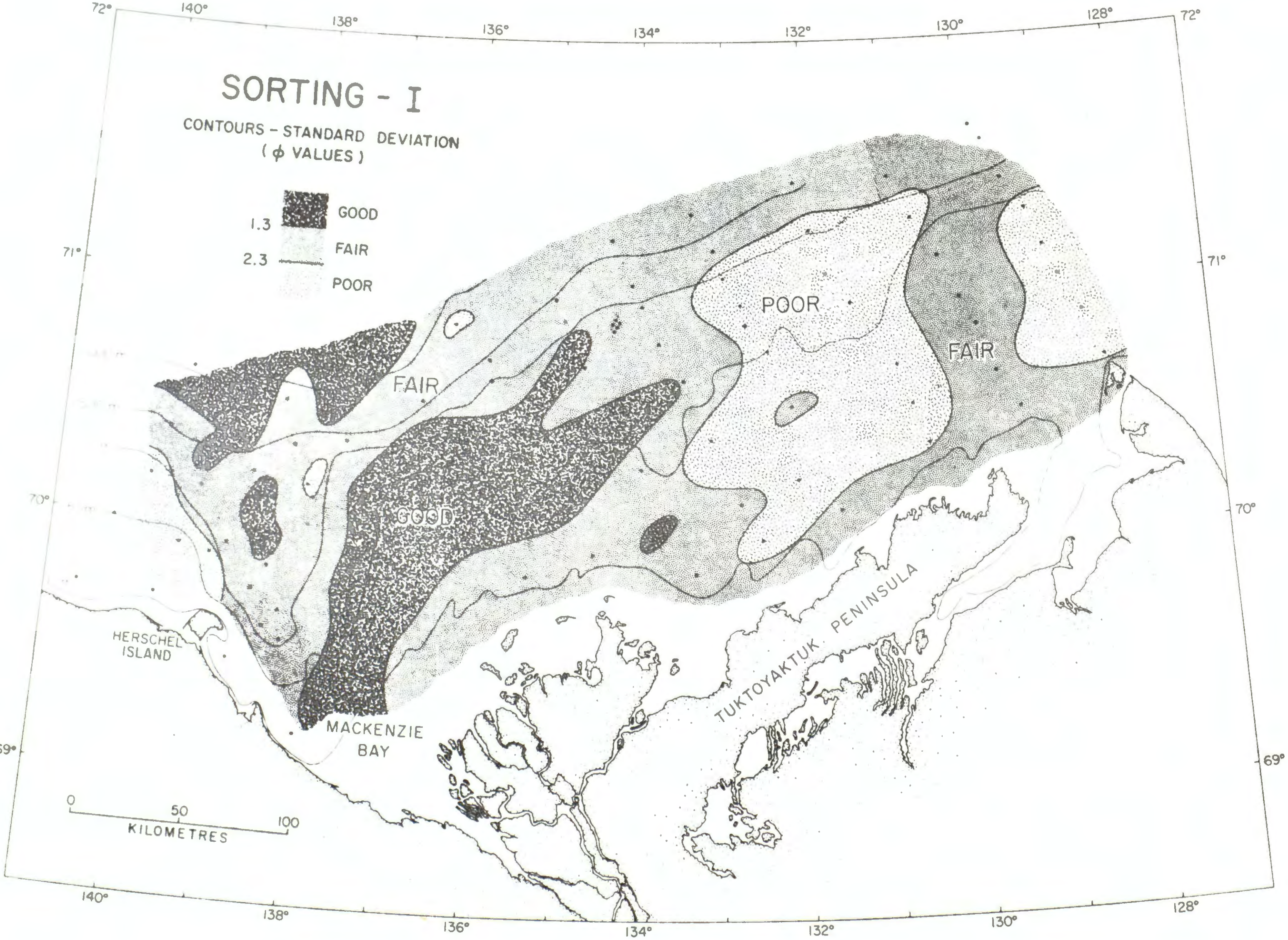

Fig. 8 Sediment sorting on the basis of moment measures. Phi values of standard deviation show areas of good sorting which are generally occupied by clay-sized particles.

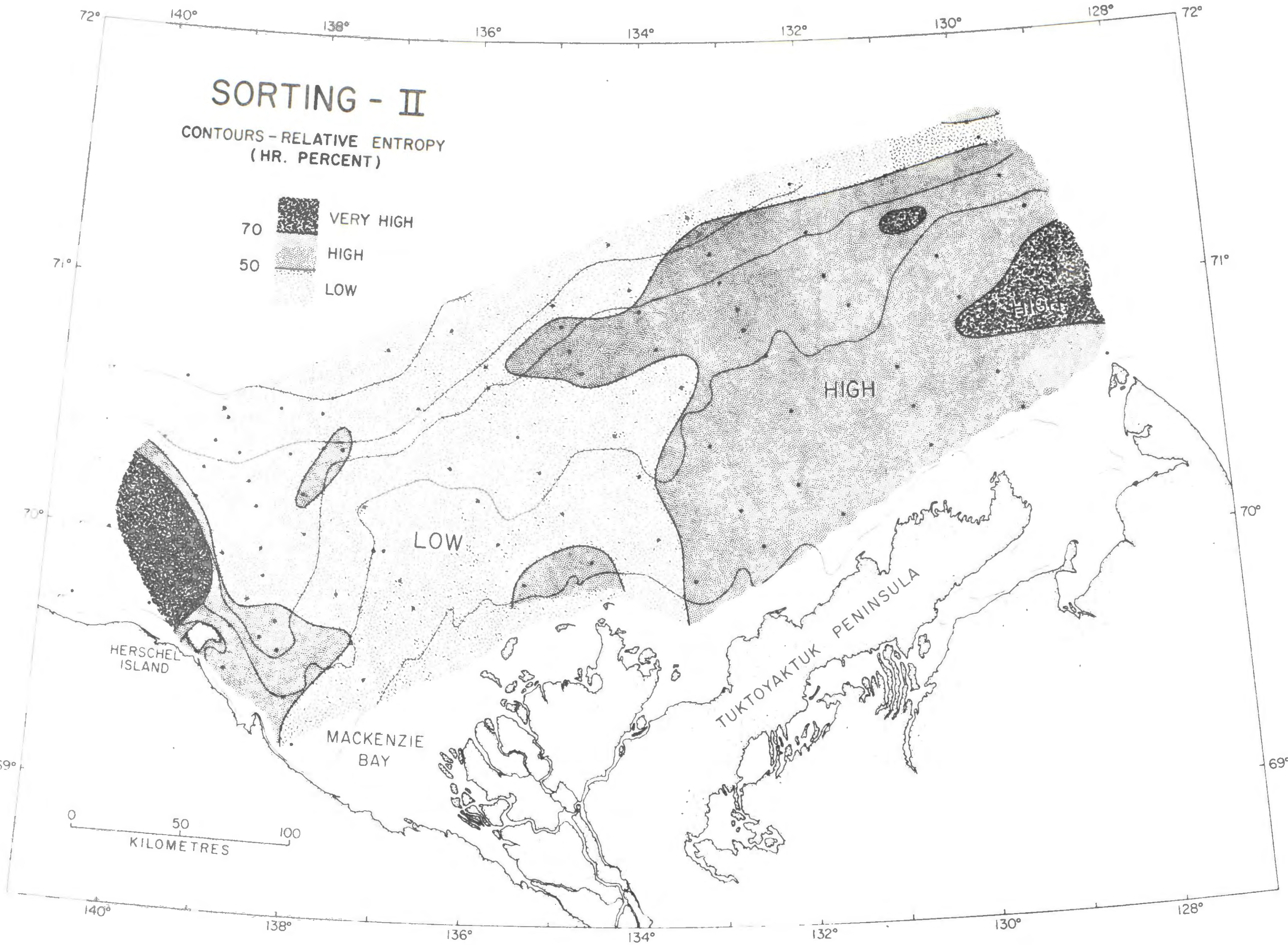

Fig. 9 Sediment sorting based on relative entropy shows areas of low entropy (good sorting) and areas of high entropy (poor sorting). These areas clearly indicate contrasting processes of sedimentation.

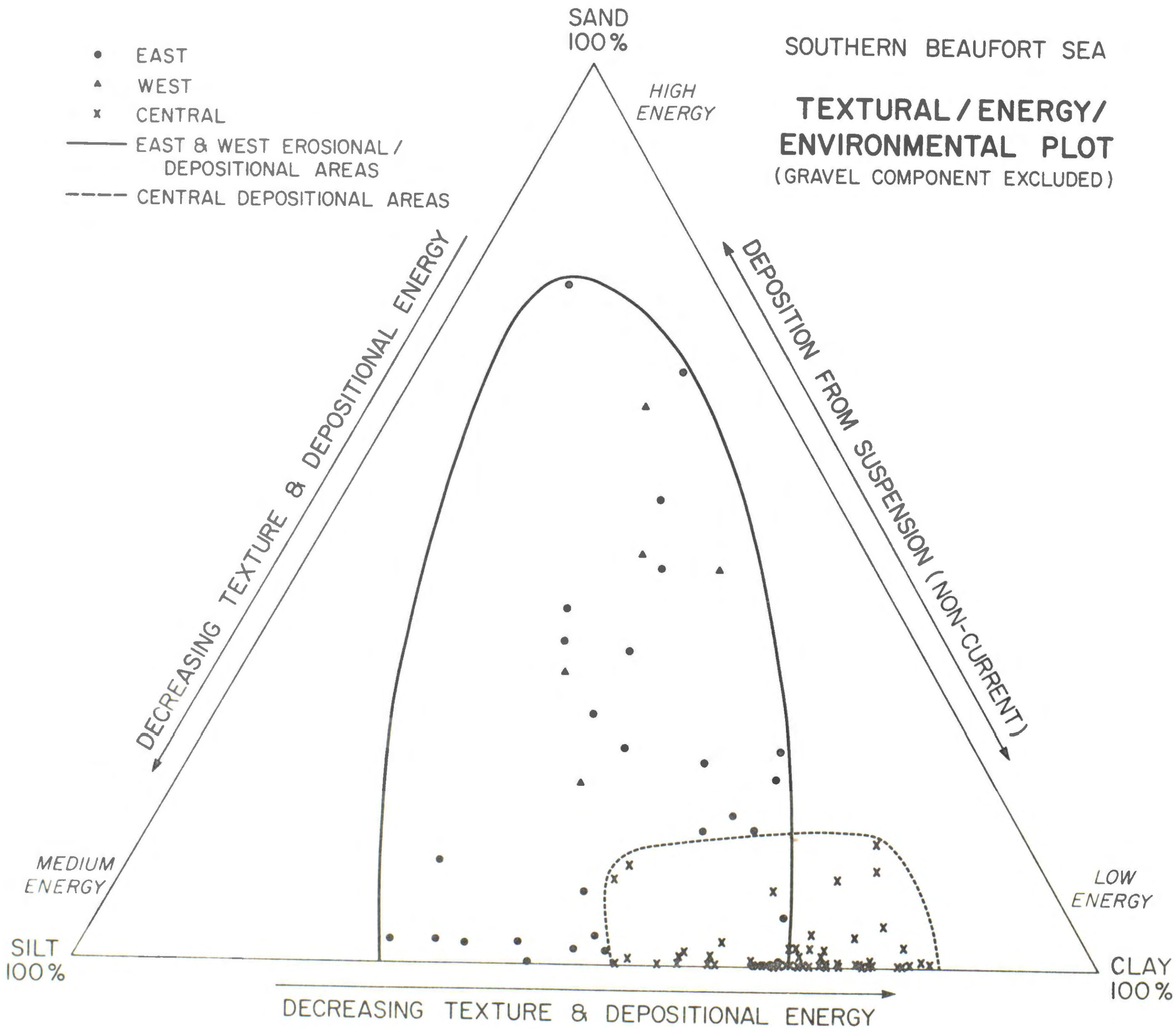

Fig. 10 Ternary diagram showing distribution of major textural classes in each sample. Two major deposition environments are suggested by the two concentrations of sample plots in different parts of the diagram.

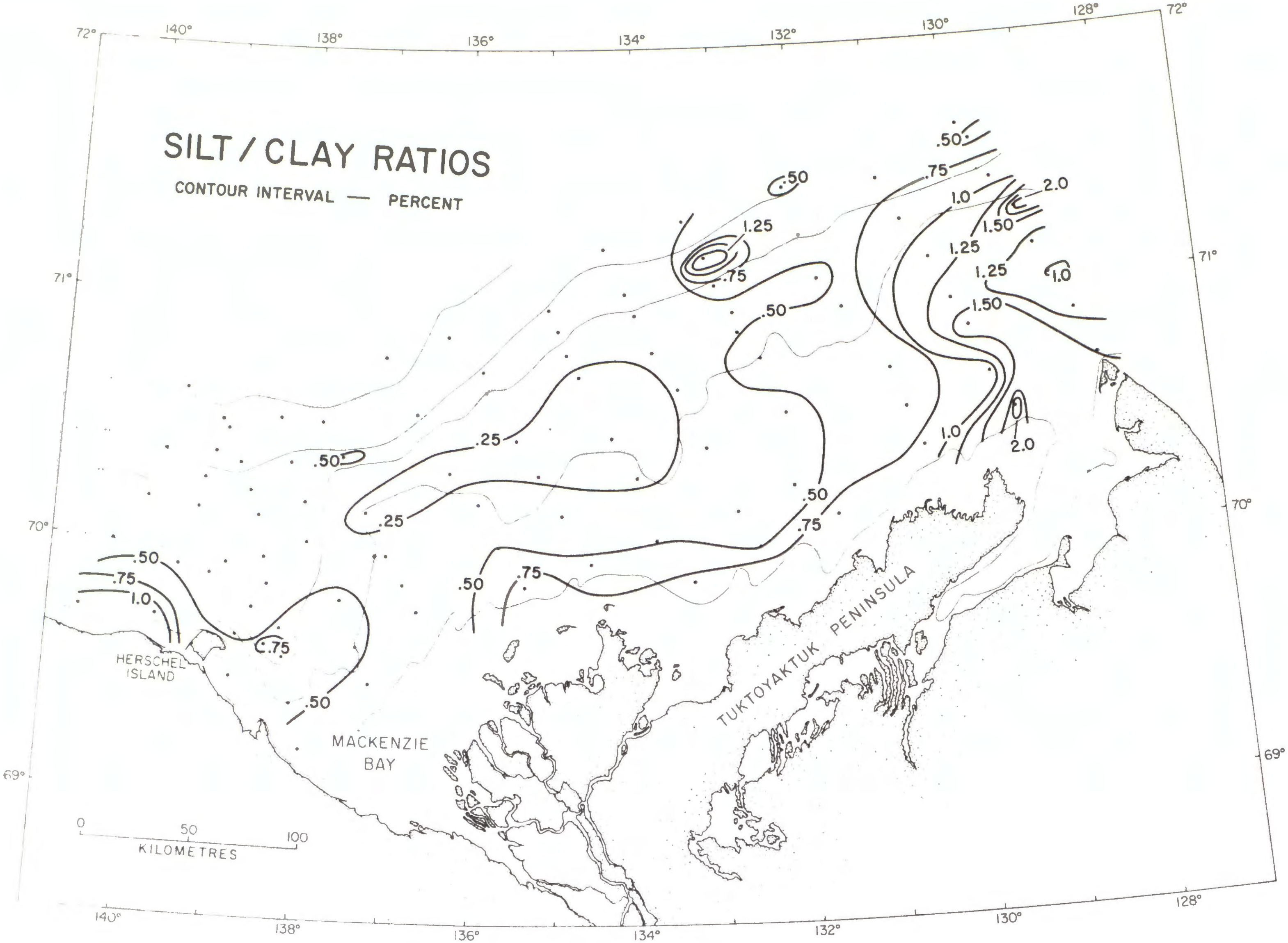

Fig. 11 Distribution of silt/clay ratios for bottom grab samples. High ratios suggest more dynamic conditions at the depositional site, such as the east and west ends of the shelf, and low ratios suggest less turbulent sedimentation such as in area north and northeast of Mackenzie Bay.