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DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

LAG DEPOSITS OF BOULDERS IN STEFANSSON SOUND; BEAUFORT SEA, ALASKA

BY

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This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature.

INTRODUCTION

During September, 1978 the R/V KARLUK was used in a systematic survey of the size and configuration of the "Boulder Patch" in Stefansson Sound,a unique type of sea floor within the Beaufort Sea shelf area between Cape Halkett and Flaxman Island. The Boulder Patch is characterized by a surface veneer of pebbles, cobbles, and boulders, up to 2 m in diameter, and supports a rich and varied benthic community.

Recognition of the fact that the Boulder Patch represents a unique biological environment, largely protected from the forces of the ice, characterized by very slow rates of deposition, and containing a suitable substrate for benthic organisms, has led to the possibility of providing special protection for this area. A marine biological research project initiated in 1978, is making a comprehensive study of the marine fauna and fauna and flora in several locations within the Boulder patch.

The presence of the Boulder Patch with a rich marine fauna was originally established on the basis of surface samples collected in 1971 and 1972, followed by three diving traverses. During the summer of 1973 the R/V LOON, equipped with side-scanning sonar and subbottom profiling equipment, was used in an attempt to define the extent of the Boulder Patch. This attempt was unsuccessful due to poor detection of boulders on the sonar. Research continued in 1976 when several vibracores were taken in the vicinity, one of which was in the middle of an area known to contain boulders. Also, an additional SCUBA dive was made in this area. In the summer of 1978 the R/V KARLUK made a systematic survey of the Boulder Patch and found that it was relatively free of ice.

In this report all available data from previous years and that obtained in 1978 have been compiled and analyzed. The report also contains a short discussion on the origin of the Boulder Patch, possible locations of similar patches of boulders, information about present and past ice rafting, and evidence from the Boulder Patch indicating the absence of modern sediment deposition across the Sagavanirktok Delta front.

METHODS

Station locations and survey tracks pertinent to this study are shown in Figure 1. The legend identifies types of survey equipment operated along the individual traverses. The equipment includes: side-scanning sonar, the Raytheon RTT-1000 system with both a 200 kHz narrow-beam transducer for bathymetry and a 7 kHz transducer for subbottom information, a Uniboom subbottom profiling system, and a Simrad "Partner Sounder" operating at 38 kHz.* The essential elements of the trackline survey and location of vibracoring stations were controlled with a Del Norte trisponder system for navigation, and the fixes are accurate to within $\pm$ 5 m. Surface sediments were usually collected with grab samplers. In some cases a gravity corer was used, but penetration was always less than 20 cm. These sampling stations were fixed with sextant angles, dead reckoning, and radar. Their accuracy could be in error by as much as 600 or 700 m.

The analysis and discussion of vibracores are presented by Barnes et al., (1979). The descriptions of all surface sediments collected by these various techniques are shown in figure 1 and the percentages of gravel, sand, and mud in the samples analyzed are given in Appendix A. Most dives in this area were made in 1976. Reports on these dives, generally coupled with pre-dive surveys

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using side-scan sonar and other techniques, were given by Reimnitz and Toimil (1976a, and 1976b). Reports on earlier dives made in the Boulder Patch are given in Appendix B.

RESULTS

The most reliable trackline survey tool for delineating the presence or absence of boulders is the Simrad depth sounder. Samples of such a record are shown in Figure 2. The Simrad bottom signal in the area of the Boulder Patch is characterized by elongate return signals, "whiskers" pointing downward, and slight surface roughness. The reliability of these criteria for recognizing the Boulder Patch was verified by four dives. An example of the Raytheon RTT-1000 record is given in Figure 3. On calm days the fathogram obtained with a narrow beam transducer shows rough relief within the Boulder Patch, with individual boulders shown as spikes. But in general the Boulder Patch is not as clearly defined on the Raytheon records as in this example. The 7 kHz subbottom records printed slightly below the fathogram are generally of little use in defining the Boulder Patch. An example of an exceptionally good sonograph is shown in Figure 4. On the left side of this figure is a 200-m wide zone with just a few scattered boulders shown as small black spots. The rest of the sonograph shows a large number of boulders as very small point source reflectors and a generally dark background suggesting coarse-grained material. A few 3-5 m diameter patches of low bottom reflectivity probably represent small pockets of muddy sediments among the boulders. The sonograph also shows small, irregular lineations that trend obliquely across the ship's track. These lineations are probably small ice gouges. The small size of the ice gouges here may be due to the lack of modern marine sediment and a very firm bottom. The irregularity of the gouges is attributable to the topographic local deflection of ice floes by the rough relief in the Boulder Patch.

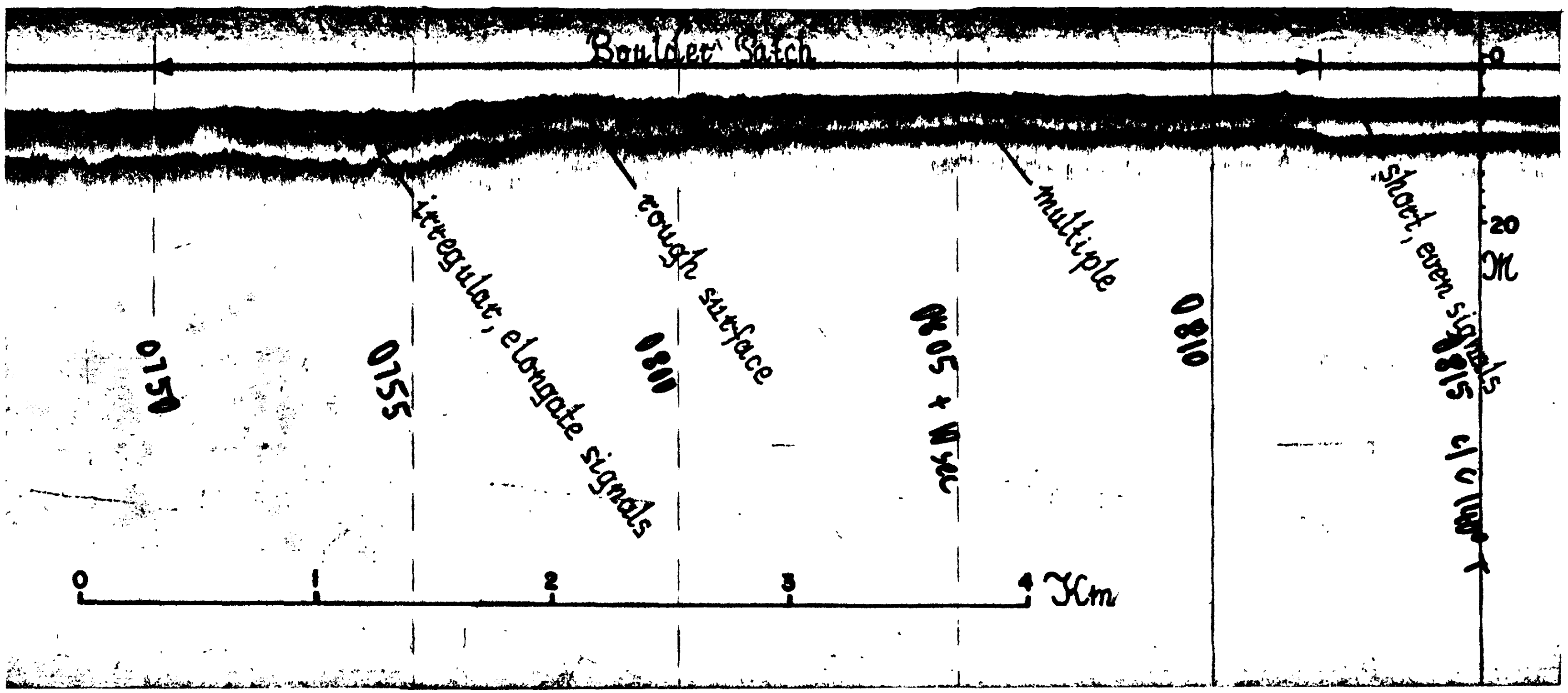

Figure 2. Thirty-eight kHz depth recorder trace of boulder patch, characterized by irregularly elongated signals and slight surface roughness. The outer edge of this boulder patch lies at about 0812 hrs. (See Figure 1 for location.)

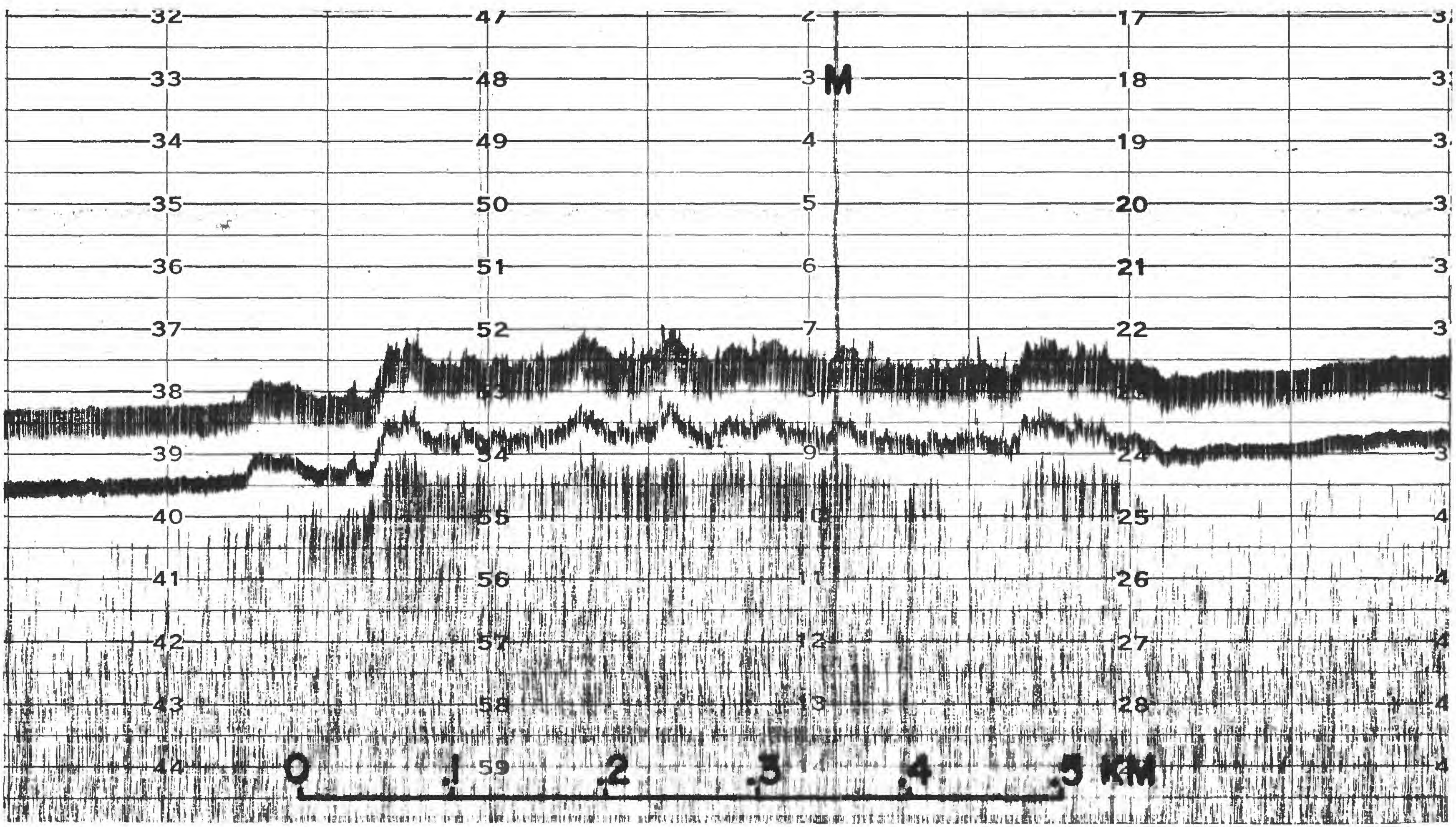

Figure 3. Bottom traces from the 200 kHz (upper) and 7 kHz (lower) systems used during most of the boulder patch survey. The upper trace shows the surface roughness within the boulder patch, with individual boulders protruding by up to .5 m above the sea floor. (See Figure 1 for location.)

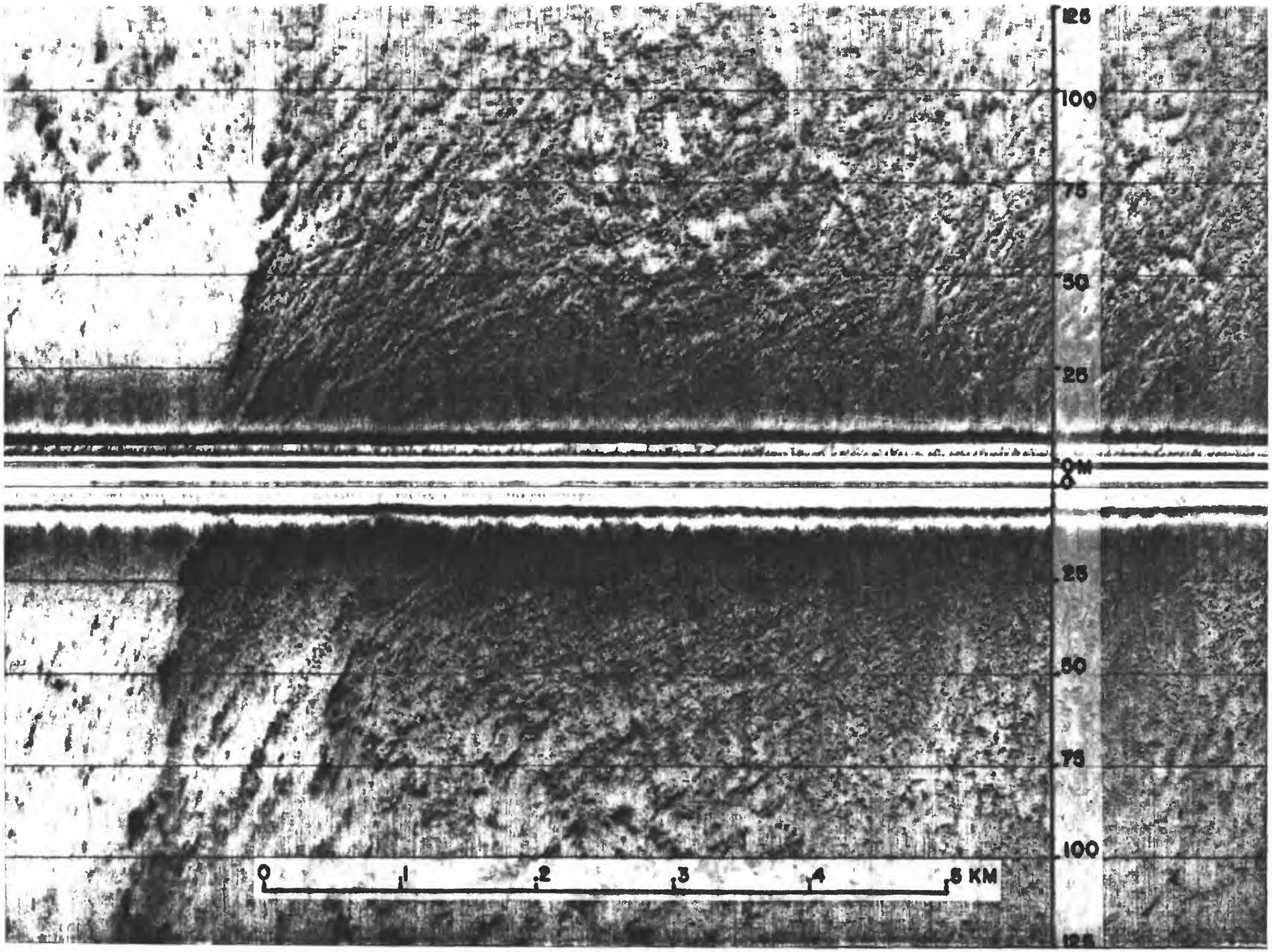

Figure 4. Sonograph of the margin of the boulder patch where the margin is exceptionally well developed. Individual boulders and a few small, irregular ice gouges are discernible. (See Figure 1 for location.)

In some areas classified as Boulder Patch on the basis of Simrad records, the sonographs were not of adequate definition to serve as supporting evidence. This lack of definition of the side-scanning sonar system was described (Reimnitz and Toimil, 1976a) as being lush and abundant marine growth, which causes diffusion of high-frequency signals. However, along a large percentage of the trackline coverage, the side-scanning sonar was useful in providing supporting data.

The compilation of all available data defines the Boulder Patch as shown in Figure 5. The boulders do not occur in a continuous field but as patches of various sizes. Distinction is made between clearly identifiable and dense boulder bottom and transition areas, where finer sediments dominate, or where the interpretation of our data is uncertain.

Another type of bottom distinguishable from surrounding regions by elongate, diffuse bottom signals (Fig. 5). These bottom signals are of constant length, as opposed to the variable-length signals within the Boulder Patch. This acoustic character is associated with smooth sea floor and is therefore different from the patch. Sediment samples do not show unusual deposits. Because these areas of diffuse signals of unknown origin occur in the deep portion of Stefansson Sound, we believe that diffusion might be due to the presence of a soupy, transient layer commonly observed in our SCUBA diving program. Such soupy materials can be up to 1 m thick in local depressions, and generally are much finer than materials on the solid sea floor.

Although acoustic penetration is generally poor in Stefansson Sound, there are several good sections in our seismic reflection records which clearly indicate that the boulders on the shelf surface here coincide with areas of thin, or absent, Holocene marine sediments. A line drawing of such a

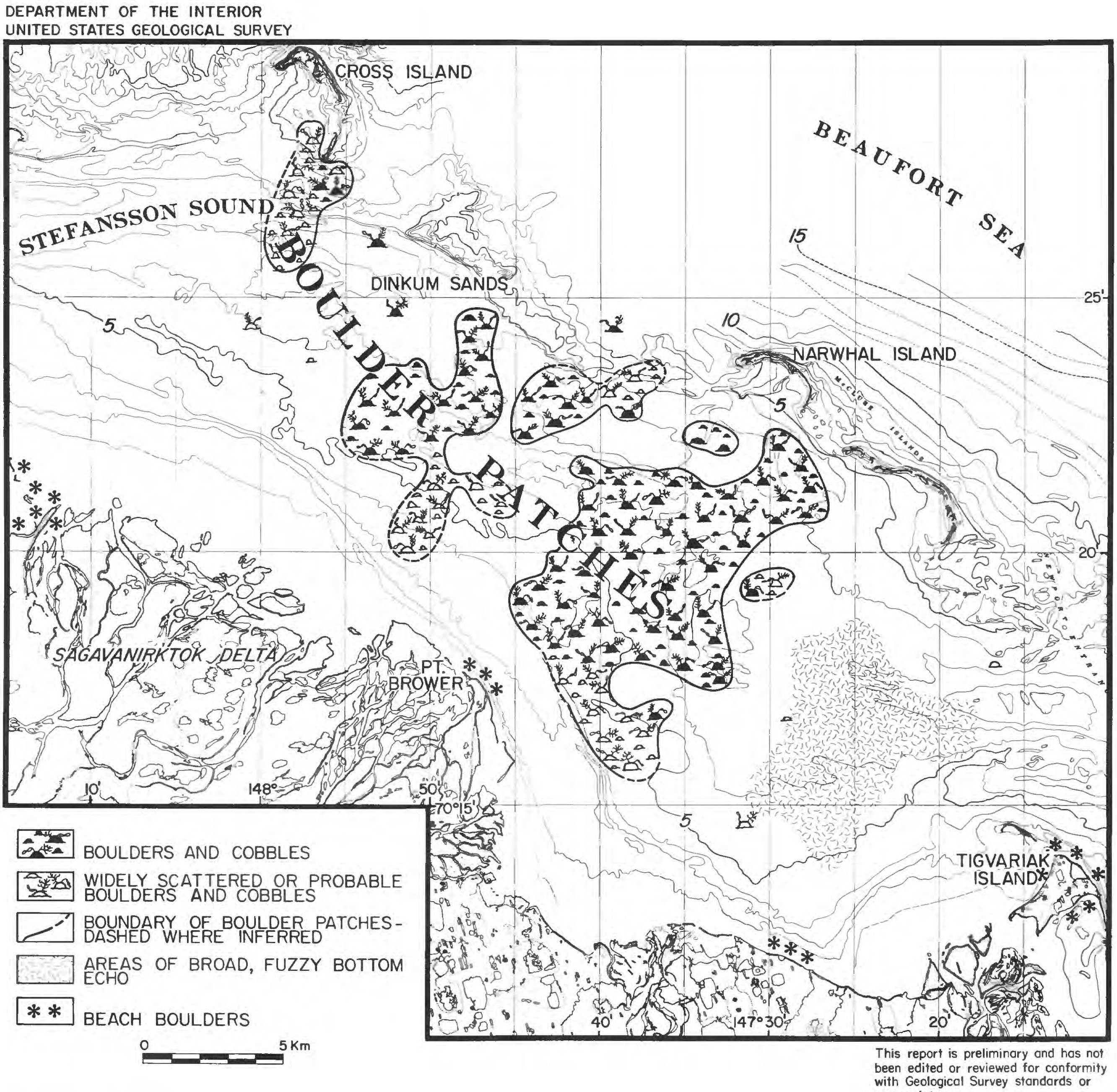

Figure 5. Location of boulder patches. The compilation of trackline data shown in Figure 1 was used to define boulder patch boundaries.

seismic reflection record is shown in Figure 6. The location of this seismic record is shown on Figure 1 as extending from Narwhal Island southwestward towards the Sagavanirktok Delta. In the left portion of this record a thin unit of surface sediments overlies an indistinct and highly irregular, discontinuous bottom reflector. At the point where other data (including side-scanning sonar and the Simrad record in particular) indicate a transition into boulder bottom, a very disinct subbottom reflector crops out at the sea floor. Landward of this point there are several seaward-dipping subbottom reflectors that are truncated by the sea floor, showing that the sea floor here is an erosional surface.

Our diving traverses in different parts of the boulder patch show that the boulders occur only in a thin layer - a layer which is no more than one boulder thick. According to the 200 kHz bottom record showing boulders as spikes above the surrounding sea floor, the maximum height of the boulders is about 70 cm. However on our dives we have seen boulders with horizontal dimensions of up to 2 m.

DISCUSSION

Deposits of gravel, cobbles, and boulders similar to those found in the boulder patch of Stefansson Sound are formed today during the process of coastal erosion of the Gubic Formation in a number of present day beaches. Leffingwell (1919) was the first to summarize all information on the occurrence of such boulders along the arctic coast of Alaska and to recognize that the lithology of many of these is foreign to the drainage basins in which they are found today. Leffingwell used the name Flaxman boulders, subsequently other writers have added to our knowledge of the distribution and possible origins for these boulders (McCarthy, 1958; Rodeick, 1979; and Hopkins and Hartz, 1978). That portion of the boulders foreign to Alaska was

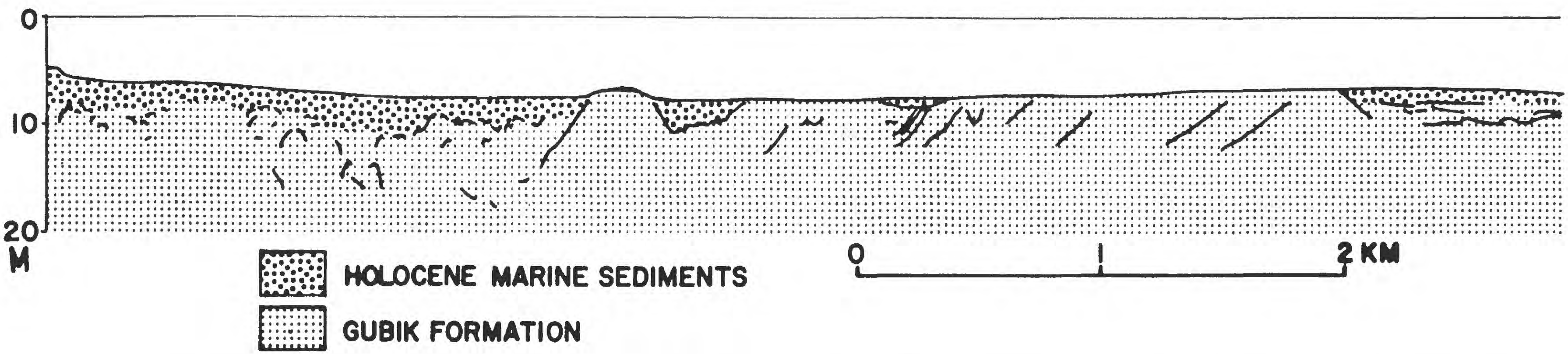

Figure 6.- Line drawing of 7 KHz seismic sub-bottom record across a boulder patch, showing that here the sea floor is an erosional surface. Vertical exageration is 1 : 45. For location of this cross section refer to figure 1.

probably rafted by ice from areas in Canada that lie east of the MacKenzie River.

Boulders can also be seen sparsely scattered through the section of the Gubic Formation exposed in bluffs in numerous places. For example, on Flaxman Island, the boulders are very noticeable on the tundra surface of the surrounding beaches and in shallow water. The mainland coast to the east of the island also has boulders eroding out of the section and forming a thin lag deposit on the beach and in the shallow nearshore areas out to a depth of 1 or 2 m. Similar lag deposits are seen at Tigvariak Island in the eastern part of Stefansson Sound and along the Sagavanirktok Delta front, where deposits of the Quaternary Gubic Formation relatively rich in Flaxman boulders are being eroded back (Figs. 5 and 7).

The concentrations of boulders within the Gubic Formation are especially high at Heald Point on the east side of Prudhoe Bay and at Tigvariak Island, both lying in this study area. These observations, coupled with the seismic reflection data, indicate that in parts of the boulder patch, where the sea floor is an erosional surface, the thin layer of gravel, cobbles, and boulders is a lag deposit resulting from the erosion of boulder-rich portions of the Gubic Formation. In this area the Gubic Formation may have occurred in the form of islands similar to Foggy, Howe, and other islands along the Sagavanirktok delta front. Thus the boulder patch is not an outcrop of a boulder unit, nor is it a morainal deposit.

In some localities, as for example at Pt. Brower, at Heald Point, and along the east side of Prudhoe Bay, boulders and other coarse beach material are resting at sea level on very stiff, cohesive, silty clay that seems to have been laid down during the coastal retreat. A combination of various processes, including solifluction and alternate freezing and thawing, may

Figure 7. Scattered boulders in a drained lake bed, about 3 m above sea level near Heald Point.(Fig. 1) The underlying Gubik Formation here is rich in boulders and coastal retreat combines these with surficial ones at beach level.

separate the fine portions of the Gubic Formation - silt and clay - from the coarser material forming the beach. This fine, silty clay lies underneath the beach and overlies the Gubic Formation and can be seen extending out through the swash zone, with boulders resting on top. In our four dives we have not seen stiff, silty clay underneath the boulders. The vibracore from the boulder patch also does not show a stiff, silty clay. However, Dunton and Schonberg (1979) report stiff silty clay occurring in at least 3 out of 16 of their biological dive sites. The spotty occurrence of overconsolidated silty clay under the boulder lag deposit would fit a process of formation of silty clay during the transgression. How this silty clay becomes so firm and "overconsolidated" is not known; alternating freezing and thawing is one possibility (Chamberlain et al., 1978). But we believe this may be a nearshore process.

Observations on the occurrence of boulders along the beaches of the Beaufort Sea suggest that deposits similar to those of the boulder patch could have formed elsewhere. However, in our work with small vessels along the coast we have only seen boulders in the nearshore zone and a few submerged ones while diving. Apparently modern marine sediments in most areas are covering the boulders before the coastal bluffs have retreated very far from the site.

A few scattered boulders have been found by us in diving in Leffingwell Lagoon not far from Flaxman Island. Boulders have also been seen a short distance offshore from Flaxman Island in a survey using a closed circuit television system. Large cobbles have been seen during diving operations nearshore and seaward of Narwhal Island and Cross Island. Off the two latter islands, where the stamukhi zone impinges on the islands and the bottom is reworked intensively by ice gouging, the boulders do not have any marine growth and are clean. Off Flaxman Island, however, where the stamukhi zone and region of most intense ice gouging lie some distance offshore, a limited amount of marine growth is seen on the boulders. But marine life is not nearly as abundant as it is within the protected environment of Stefansson Sound.

The barrier islands lying seaward of the Boulder Patch region consist of coarser grained material than that of the islands lying east and west of the Boulder Patch. Hopkins and Hartz (1978) point out that Cross Island, Narwhal Island, and Jeanette Island are characterized by coarse gravel with large cobbles. Because these islands are migrating southwestward over the Boulder Patch, one may speculate that the boulders, as a lag deposit, continue seaward, below the islands, and out onto the shallow shelf. However, not enough is known about these areas and environments to speculate on the fate of the boulders after the passage of islands, and their subsequent exposure to ice processes on the seaward side of the islands.

Our study sheds some light on the process of ice rafting today, and also about conditions in the past, when Flaxman boulders were brought into the area and became part of the Gubic Formation. In several locations our records show boulders on the sea-floor surface coinciding with, and restricted to, erosional surfaces. If grounded ice in an outcrop area were to pluck out individual boulders and raft them some distance away from the outcrop before deposition on the sea-floor, a 'halo' of boulders surrounding the older materials would be the result. The lack of such 'halos' suggests that today the process of ice rafting is not a very effective transport mechanism. Futhermore, the fact that boulders in Stefansson Sound are associated with a very abundant marine fauna, and especially with durable encrusting organisms and shell material, suggests that the Flaxman boulders found on land within the Gubic Formation were deposited in a different environment. We have looked in detail for evidence of marine life adjacent to boulders in the Prudhoe Bay area; on Heald Point, at Point Brower, on Tigvariak Island, on Flaxman Island, and elsewhere, and found none. If these boulders were indeed rafted into the area in the past and deposited in the shallow water environment, such areas must have been unprotected by barrier islands, as the conditions were evidently unfavorable for establishment of a marine fauna. A lack of protection by barrier islands, in turn, suggests that the Gubic Formation, where boulder-rich, was reworked extensively by ice gouging. The lack of marine organisms surrounding the Flaxman boulders on the other hand could also be attributed to high rates of sediment deposition and therefore unfavorable conditions for marine life at the time of ice rafting.

The existence of a boulder bed or a lag deposit across the entire front of the modern Sagavanirktok Delta, one of the largest in northern Alaska, remains as a fundamental problem that needs explanation. Our data show a similar lack or scarcity of modern deposits off the Putuligayuk River in Prudhoe Bay, off the Kuparuk River, and off the Colville River, suggesting that some process is removing the sediment, or that very little is being supplied by arctic rivers.

Winter diving investigations in the eastern portion of the Boulder Patch (Reimnitz and Dunton, 1979), provide some new insights into possible mechanisms to remove sediments from the area. They found much higher water turbidity in mid-November, 6 weeks after river discharge, wind waves, and wind-driven currents had been shut off by the new ice cover, than at any time during the summer. Bright red lithothamnia covering boulders, and shiny brown kelp were blanketed with a thin cover of fine ooze. Below the solid and smooth fast-ice canopy was a soft ice layer, ranging in thickness from 0.5 to

2.5 m, consisting of large crystal platelets and very fine-grained ice with incorporated sediment. Evidently anchor ice had formed on the sea floor in early to middle October, and risen to the surface with fine sediments. This mechanism seems to have operated only in the Boulder Patch. Once sediment is suspended in the water or in the ice, only a slight current or ice displacement during spring breakup is required to transport the sediment away from the site. Dunton and Reimnitz (1979) speculate that mechanisms leading to the necessary supercooling of the water and to the formation of anchor ice may involve the interaction of fresh water with sea water in the vicinity of the arctic rivers. The lack of deltaic sediment accretion on the Boulder Patch will remain an unsolved problem until environmental data for this area becomes available.

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Dive Site 72-13
Sampling Station #156
Date: August 22, 1972
Vibisility: 2.5 m
Depth: 6.5 m
Sea conditions: Calm

Location: 70°20.2'N, 147°37.5'W
Divers: Reimnitz and Rodeick
Length of traverse: 400 m
Supplemental data: Rock samples

Kelp and pebbles covered with marine growth, collected at several stations in the general vicinity (Figs. 1,2, and 3), and the appearance of fathometer records obtained in the area, suggested unusual bottom conditions. A dive therefore was made here and in two other spots in the general vicinity of Stefansson Sound. Along a bottom traverse of about 400 m we saw a large number of rocks, often quite large, scattered on a sea floor of mud to sandy gravel. The rocks commonly are angular, but there also are rounded ones. They have diameters of up to 2 m and stand more than 1 m high above the sea floor. Abundant kelp and a large variety of benthic organisms are attached to the rocks. A sample of the types of organisms seen is given for dive site 72-14; where conditions are similar. A number of shells and rocks up to 25 cm in diameter were collected. About 30 percent of the bottom along the traverse was covered with mud. The mud is soft enough so that it can be penetrated by hand to a depth of 10 cm. Another 30 percent of the bottom is covered with sandy gravel with rather angular clasts. This sandy gravel, commonly with marine growth, is difficult to penetrate with a hand. A few, mainly very faint, ice gouges were seen. One of them had up to 30 cm of vertical relief and a well-developed ridge about 15 cm high on one side. But in general there is very little ice gouging in this area.

The cobbles and boulders are not rafted into this area under present conditions and therefore have been there for a long time. The rocks show no signs of getting buried at this time, and observed patches of mud are very thin. Thus the rocky bottom represents a relict deposit. The proximity of the Sagavanirktok delta makes the relict deposit an enigma.

DIVE SITE 72-13
SAMPLING STATION # 156

Dive Site 72-14
Sampling Station #157
Date: August 22, 1972
Visibility: 2 m
Depth: 6.5 m
Sea conditions: Calm

Location: 70°19.4'N, 147°38.0'W
Divers: Reimnitz and Oesterle
Length of traverse: 400 m
Supplemental data: Chips of cobbles and boulders

Dive site 72-14 was selected on the basis of the appearance of the fathometer record: slightly irregular bottom relief and a broad, mushy appearance of the bottom trace with "whiskers". We swam a total distance of about 400 m and found only a few scattered cobbles and boulders when compared to dive site 72-13. Also the boulders were smaller; the largest with a diameter of about 1 m. These rocks are lying on a sandy mud bottom and show no evidence of being buried by sediment. Many small rock fragments, commonly of pebble size, and angular in shape are scattered about on this sandy mud bottom, and most of the rock fragments have organisms attached. A crust of marine growth is common for all pebble, cobble and boulder-size material in this area. The sea floor along the bottom traverse is rather smooth with slight undulations, apparently from ice gouging, but there are no recent ice gouges. On a small scale there is micro-relief due to the burrowing activity of benthic organisms and from trails made by snails, isopods and chitons. One of the divers, Andy Oesterle, with a background in marine biology, described some of the marine life observed along this traverse as follows: some small neptunia, a sea cucumber, crabs, nudibrancs, many varieties of star fish, several types of polychaete worms, sponges, one fish resembling a blenny eel, and another small spotted one, anemonies and stalked worms, chitons, large brown algae (laminaria), other algae including red ones, a number of what may be colonial hydroids (very pale pink stalks with reddish tufts of tentacles protruding from the branches of stalks and rising up to 30 cm above the rock substrate. Many clam shells were found and one of these was a large burrowing clam with a 6-cm-long neck. Fourteen rock chips were collected by the use of a hammer; half of them were taken from angular boulders and cobbles and the other half from rounded ones. These fragments include quartzite, granite, and dolomite clasts. The large variety of marine organisms, the rocky nature of the bottom, and a fair visibility made this dive an unforgettable event in our Beaufort Sea diving program.

Dive Site 72-15
Sampling Station #158
Date: August 22, 1972
Visibility: 1.2 m
Depth: 7 m

Location: 70°21.7'N, 147°34.2'W
Divers: Reimnitz and Rodeick
Length of traverse: 400 m
Supplemental data: Rock chips collected

This third dive site in Stefansson Sound was also chosen on the basis of the appearance of the fathometer record. The fathometer was run along the line from dive site 72-14 to this station and the record shows patches of irregular bottom with a broad, mushy return suggesting rocks and kelp, alternating with smooth bottom areas either with- or without kelp. At the dive site the width of the fathometer trace did not suggest the presence of kelp but the trace was very irregular. On the first part of the dive, for a distance of about 100 m, we were traversing a very dense rock cover. The rocks generally are angular and have diameters up to 1 m, but range down to pebble size. Within this rocky bottom area there are small patches of sandy mud containing many pebbles and several subtle depressions containing mud, up to 20 cm thick, overlying gravel. Accumulations of almost pure clam shells (astarte) were seen. One of these shell deposits was 10 cm deep. Only some of the clams were still alive. Along this first 100 m of diving traverse through dense rock cover is a large variety and abundance of marine organisms, but only a little kelp. The remainder of the traverse covered areas of mainly rather smooth, sandy mud bottom with scattered rocks and pebbles, all of which again had attached marine growth. Here rocks were gradually being buried by sedimentation. No evidence for ice gouging was noted. The marine fauna along the first 100 m of the traverse was more abundant than anywhere within areas covered at dive sites 72-13 or 72-14. The visibility was poor due to suspended organic matter in the form of translucent small flocks.

DIVE SITE 72-15
SAMPLING STATION # 148

DIVE SITE 72-15
SAMPLING STATION # 158

1970-1972 BEAUFORT SEA SAMPLE DESCRIPTIONS

Location Number	Field Number	Description
105	71AJT5	Worm tubes on top, some clays and silts, poorly sorted. 3% gravel, 80% sand, 17% mud. Predominantly coarse sands (largest particles <7 mm).
106	71AJT6	Fine sand, well-sorted, <5% silt, no biology seen. 0% gravel, 98% sand, 2% mud.
107	71AJT7	Silt, some bottom fauna. 0% Gravel, 81% sand, 19% mud.
108	71AJT8	Silt, one fish, one live pelecypod, one plecypod valve, worms. 0% gravel, 48% sand, 52% mud.
109	71AJT9	Sand, silt and clay, with assorted gravel, <2.5 cm, subrounded, no sorting. 40% gravel, 40% sand, 20% mud.
110	71AJT10	Fine to very fine sand, small pelecypod, some silt. 0% gravel, 82% sand, 18% mud.
111	71AJT11	1 cm of olive grey clay, high water content, - on top of greyish black clay, slightly silty, apparently highly organic because of color. One segmented worm. 0% gravel, 15% sand, 85% mud.
174	70BS18	Fine sand, traces of organic matter.
205	71AER27	Fine, light grey, silty sand, no structures or organisms.
206	71AER28	Slightly sandy gravel (area is 90-95% gravel), driftwood chips. Some laminaria and very fine fibrous algae. Right outside of beach the bottom turns to fine, silty sand.
207	71AER29	Medium-grained grey sand.
208	71AER30	Medium-grained, well-sorted sand.
209	71AER31	Medium-grained, grey, slightly silty sand/finer brownish oxidized sand in upper 1.5 cm.
210	71AER32	Slightly silty fine-grained, grey sand. No stratification, structures, or organisms.
211	71AER33	Medium-grained, slightly silty sand in upper 5 cm, mixed with gravel-size material on bottom. Kelp holdfast with gravel and sand.
212	71AER34	2-3 cm of silty clay overlying sandy silt, polychetes, clam shell, worm burrows, some pebbles mixed in - stiff mud below.
213	71AER35	Slightly sandy, grey to dark grey mud, soft near surface - stiff below. One bivalve, no pebbles.
214	71AER36	Two samples: a) 10 cm diameter, angular rock and smaller rocks with sponges and laminaria. b) Slightly sandy mud with 2 cm sand layer, no pebbles, no shells, no organisms.
215	71AER37	Grey, soft, sandy mud at surface - very stiff at 10 cm depth. Clam shells (including Astarte) and pebbles.
216	71AER38	Slightly sandy grey mud, worms and burrows, clams, no pebbles, rusty color next to burrows and the surface layers. Stiff bottom.
217	71AER39	Medium-grained sand.
444	72AER144	Medium-grained sand.
446	72AER146	Silty sand with some shells and a few pebbles.
447	72AER147	Medium-grained slightly sitly sand with some shells.
448	72AER148	Rocks with coralline algae, kelp, sponges and very muddy sand with some pebbles and angular material.
449	72AER149	Very silty, medium-coarse grained sand with abundant, whole, large clam shells and pebbles.
450	72AER150	Sandy silt - upper brown layer grading to grey - slighlty more consolidated silty sand below.
451	72AER151	Fine, well-sorted sand, some small shell fragments, a large isopod, no mud layer on surface, no pebbles or stratification.
452	72AER152	Surface of sandy silt, silt below.
453	72AER153	Coarse-grained sand with small to medium-sized pebbles - most in lowest layer.
456	72AER156	Quartzite cobbles, gneissic granite, meta sandstone - many rocks and rock fragments.
457	72AER157	Rock chips, 1/2 of rounded, 1/2 of angular rocks, ranging from 20-40 cm in size.
458	72AER158	Rocks, shells, and algae.
705	72AJT5	Greenish grey, fine-grained silty sand.
706	72AJT6	Very fine-grained silty sand, dark, greenish clay.
707	72AJT7	Silty, clayey, fine-grained sand.
708	72AJT8	Silty clay, medium grey, high water content. 0% gravel, 11% sand, 89% mud.
709	72AJT9	Silt, very fine-grained sand.
710	72AJT10	----
711	72AJT11	----
714	72AJT14	----
715	72AJT15	Sand, silt, clay, primarily sand.
716	72AJT16	Slightly clayey silt. 0% gravel, 66% sand, 34%.

VIBRACORE SAMPLES

V-9 - Medium sand, angular, few granules and small pebble
V-10 - Sandy Mud
V-11 - Sandy mud/sand and pea gravel mixture
V-29 - Medium-grained pebbly sand, silty clay
V-30 - Fine sand
V-31 - Organic layer, fine sand