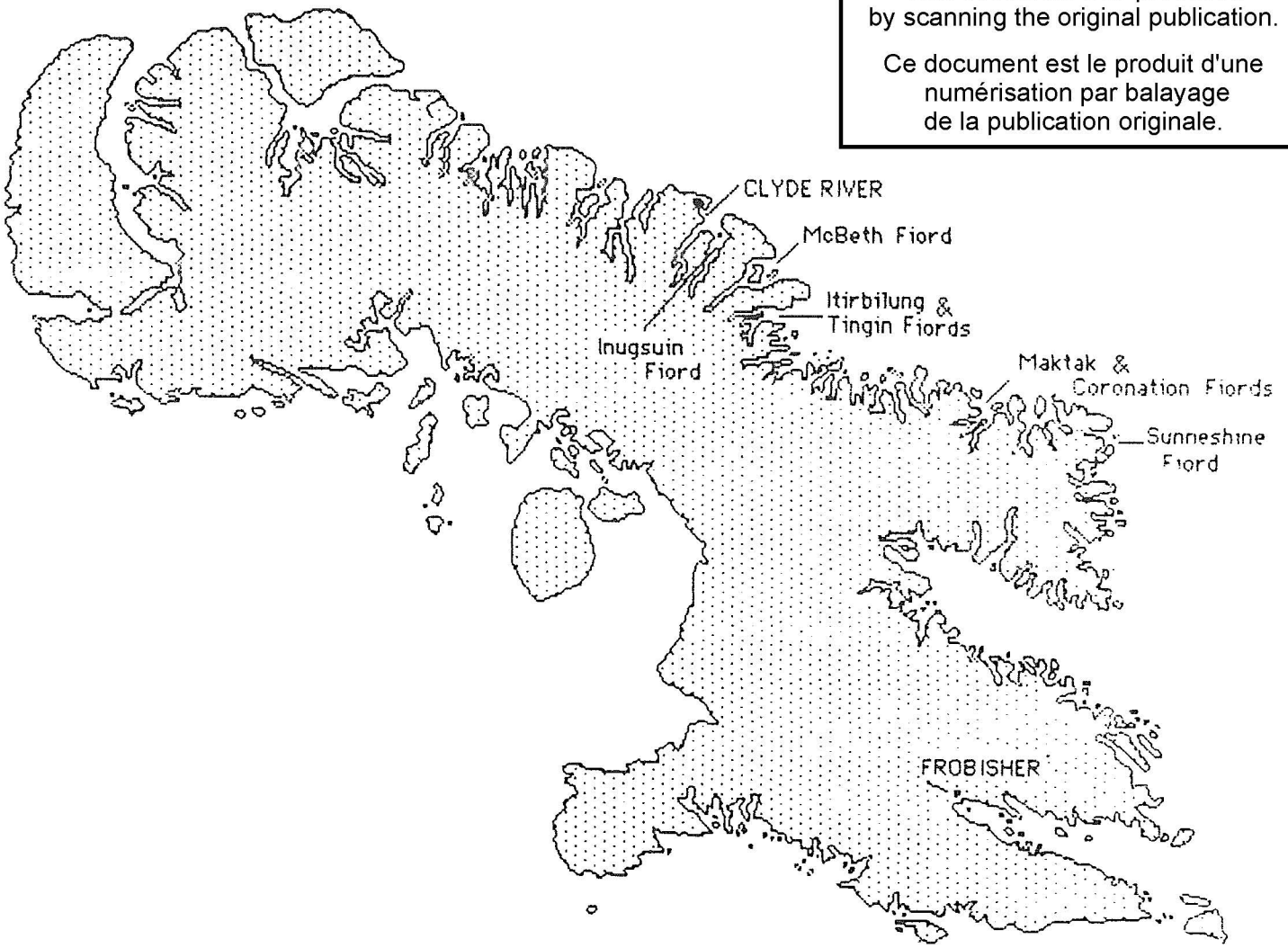
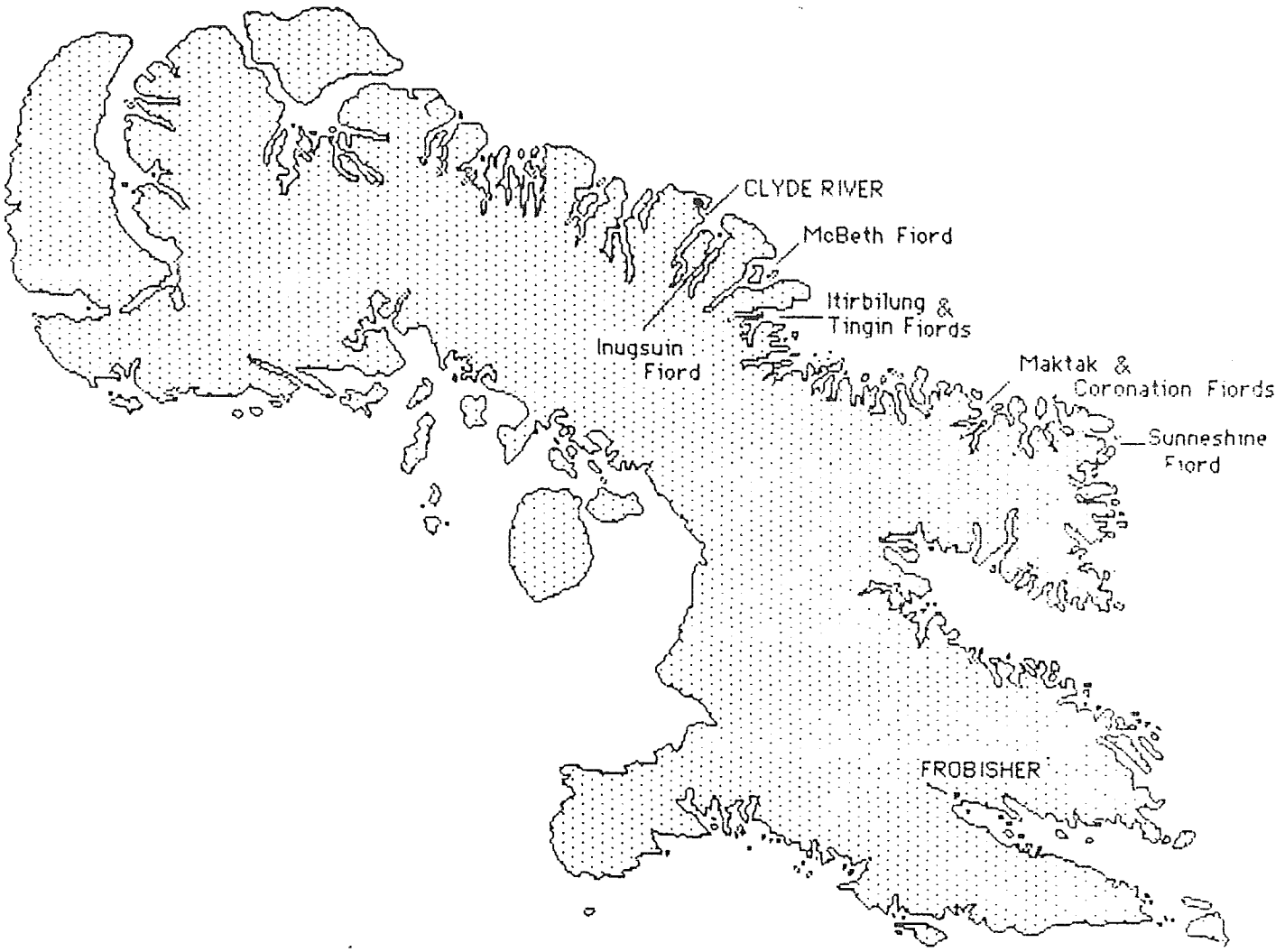


SEDIMENTOLOGY OF ARCTIC FJORDS EXPERIMENT

PANDORA/PISCES CRUISE 85-062

AUGUST 31-SEPTEMBER 18, 1985



SEDIMENTOLOGY OF ARCTIC FJORDS EXPERIMENT

PANDORA/PISCES CRUISE 85-062

AUGUST 31-SEPTEMBER 18, 1985

SEDIMENTOLOGY OF ARCTIC FJORDS EXPERIMENT

PA-85-062 EXPEDITION REPORT

by

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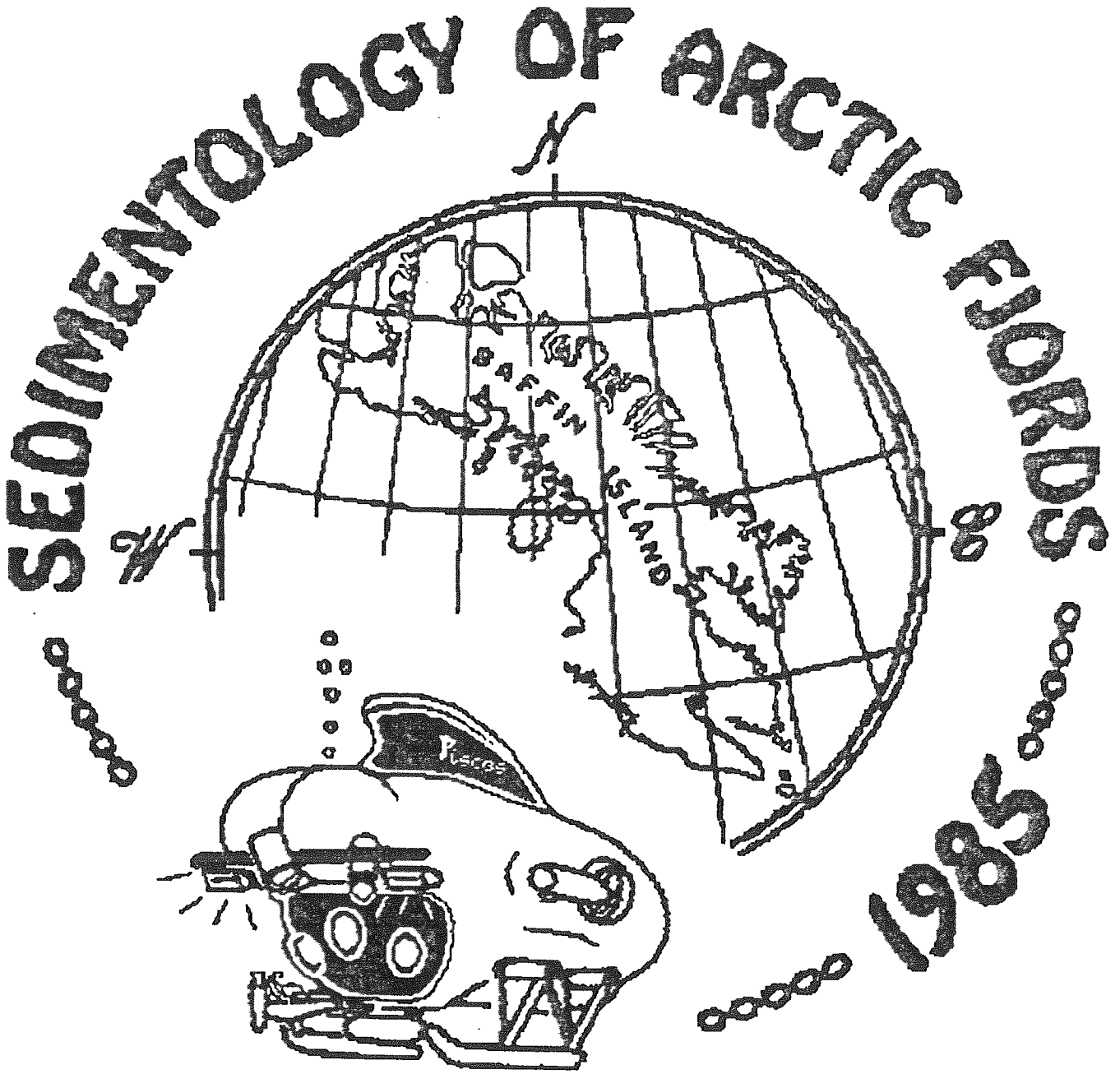
SEDIMENTOLOGY OF ARCTIC FJORDS
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INTRODUCTION

Submersibles have been included in the suite of research tools available to Canadian marine scientists for the past two decades. They have been utilized in a wide range of environmental settings up to depths of 2000 m, limited only by weather and life support systems. The Pisces IV was used on expedition 85-062 for a variety of "ground truthing' missions. These included the inspection of:

1) acoustically reflective outcrops of till-like facies (e.g. Dive 1663: Sunneshine);

2) the seafloor adjacent to tidewater glaciers (e.g. Dive 1665: Sunneshine; Dive 1667: Coronation; Dive 1678:Itirbilung);

3) sedimentation processes, including the description on the distribution of hemipelagic particles (to be further used in the calibration of the floc camera) (e.g. Dive 1673: Tingin) and observations of induced turbidity currents (e.g. Dive 1677: Itirbilung);

4) gravity flow channels on prodelta slopes (e.g. Dive 1670: Maktak) or along the deeper basins (e.g. 1675: Tingin);

5) submarine slides (e.g. Dive 1681: McBeth);

6) sidewall slope environments (e.g. Dive 1674: Sunneshine; Dive 1684: McBeth);

7) the density and diversity of the macrobenthos, based on surface expression of infauna, and epifauna--soft-bottom dwellers and epilithics (e.g. Dive 1672: Tingin);

8) the degree of bottom compaction based on ball drop experiments (e.g. Dive 1667: Coronation);

9) the frontal dump moraine of McBeth Sill (Dive 1683); and

10) the bedrock outcrops exposed in the outer fjord reaches (e.g. Dive 1680: Itirbilung).

During the first three weeks in September, 23 dives were completed in seven fjords situated along the east coast of Baffin Island. The average time of each dive was about 2.5 hours; 3.5 hours was our longest dive. The dives were dedicated mostly to observational missions. However, the Pisces IV external manipulator arm was frequently used to obtain short sediment cores or direct the head of a small suction sampler for recovering suspended particulate matter or the surficial layer of the bottom sediment. The essence of the data base described in this report is 52 hours of T.V. imagery of the subject areas targeted for submersible inspection. These data compliment geological information collected on earlier cruises and will especially aid in the interpretation of the reflection seismic and side scan sonar records.

Launch and recovery operations were run smoothly given the weather criteria under which these activities were permitted. During 85-062 the capacities of the Pandora crew and hardware seemed to be underutilized in regard to this aspect of the operation. Four days of diving operations (i.e. 8 dives) were abandoned as mostly a result of weather: one dive was given up due to a faulty valve. The cruise left Frobisher Bay 2 days later than expected due to gale-force winds (making for risky boarding of equipment and personnel). Fifty to seventy knot winds resulted in the loss of three in fjord dives.

Our recommendations for future Pisces operations include: (1) evaluation of the Pisces launch-recovery operational window, including limiting factors and possible improvements; (2) evaluation of the visual hardware systems, including stereo T.V., better pan & tilt T.V., external 35 mm

cameras; (3) evaluation of the present suite of sampling hardware with recommendations for new designs; (4) plotter for acoustic navigation system [and not simply in relation to the ship, but in real ship-corrected coordinates]; (5) sufficient pre-cruise meetings between PISCES staff and users, to detail mission particulars and to ensure that no surprises await either party; (6) availability of a ROV system on PANDORA for rough weather operations; and (7) a scientific consultant, well-experienced in submersible operations (+50 dives), should play a key role in PISCES IV operations. We believe this last point is essential for an overall improvement in federal government submersible operations.

Expedition PA-85-062 also engaged in detailed shore-based surveying of glacier icefronts and sandur/deltaic deposits. Weather stations and oceanographic moorings, that were emplaced earlier in the summer by helicopter operations, were successfully recovered. Evening operations of the Pandora included floc camera stations, CTD stations, and single and triple-Lehigh core stations. The Itirbilung prodelta seafloor was surveyed for the third field season with a Klein side scan sonar.

We would like to thank all those involved in the success of this operation, including our scientific staff, AGC and other BIO support staff, Pisces staff and Pandora officers and crew. Dr. D. J. W. Piper reviewed the document for release as a G.S.C. Open File.

-C.T. Schafer and J.P.M. Syvitski

senior and chief scientists

Table 1. Pisces dive information

Dive #		Latitude	Longitude	DATE	TIME	LOCATION
1663	62-1	66 29.3 N	61 31.2 W	04-09-85	1531 ADT	SUNNESHINE
1664	62-5	66 37.8 N	62 03.8 W	05-09-85	0942 ADT	SUNNESHINE
1665	62-3	66 35.9 N	62 04.8 W	05-09-85	1456 ADT	SUNNESHINE
1666	62-6	67 15.8 N	64 16.1 W	06-09-85	1133 ADT	CORONATION
1667	62-9	67 12.5 N	64 46.0 W	07-09-85	1043 ADT	CORONATION
1668	62-7	67 14.6 N	64 36.2 W	07-09-85	1555 ADT	CORONATION
1669	62-12	67 19.5 N	64 31.9 W	08-09-85	0927 ADT	MAKTAK
1670	62-10	67 21.2 N	64 46.8 W	08-09-85	1430 ADT	MAKTAK
1671	62-11	67 20.4 N	64 41.2 W	08-09-85	0910 ADT	MAKTAK
1672	62-17	69 06.2 N	68 53.8 W	10-09-85	1048 ADT	TINGIN
1673	62-18	69 04.1 N	68 54.4 W	10-09-85	1532 ADT	TINGI N
1674	62-15	68 59.6 N	68 57.6 W	11-09-85	0900 ADT	TINGIN
1675	62-16	69 01.7 N	68 56.7 W	11-09-85	1302 ADT	TINGIN
1676	62-19	69 16.2 N	69 15.0 W	12-09-85	1638 ADT	ITIRBILUNG
1677	62-20	69 16.4 N	69 14.5 W	13-09-85	0900 ADT	ITIRBILUNG
1678	62-21	69 18.7 N	69 07.6 W	13-09-85	1300 ADT	ITIRBILUNG
1679	62-22	69 19.4 N	68 46.3 W	14-09-85	0900 ADT	ITIRBILUNG
1680	62-23	69 15.6 N	68 04.5 W	14-09-85	1550 ADT	ITIRBILUNG
1681	62-25	69 33.3 N	69 55.5 W	16-09-85	0900 ADT	MCBETH
1682	62-27	69 33.4 N	69 38.4 W	16-09-85	1230 ADT	MCBET H
1683	62-28	69 33.1 N	69 33.9 W	17-09-85	0859 ADT	MCBETH
1684	62-29	69 31.3 N	69 19.0 W	17-09-85	1310 ADT	MCBETH
1685	62-31	70 12.9 N	68 37.7 W	18-09-85	0900 ADT	INUGSUIN

Table 1. (cont.)

Dive #		OBSERVERS	PILOT	MAX DEPTH	TIME DOWN
1663	62-1	SYVITSKI/SCHAFER	CHAMBERS	083 m	3 H ?
1664	62-5	SYVITSKI/HODGE	WITCOMBE	245 m	2H 52 MIN
1665	62-3	SCHAFER/GILBERT	WITCOMBE	150 m	1 H 34 MIN
1666	62-6	HEIN/SYVITSKI	CHAMBERS	367 m	2 H 04 MIN
1667	62-9	SCHAFER/GILBERT	CHAMBERS	092 m	2 H 03 MIN
1668	62-7	ASPREY/HODGE	CHAMBERS	246 m	2 H 07 MIN
1669	62-12	SYVITSKI/HEIN	TAYLOR	246 m	2 H 03 MIN
1670	62-10	SYVITSKI/SCHAFER	TAYLOR	090 m	2 H 20 MIN
1671	62-11	HODGE/GILBERT	TAYLOR	161 m	2 H 06 MIN
1672	62-17	GILBERT/HODGE	WITCOMBE	320 m	3 H 08 MIN
1673	62-18	SYVITSKI/HEIN	WITCOMBE	269 m	2 H 08 MIN
1674	62-15	SYVITSKI/HEIN	WITCOMBE	119 m	2 H 20 MIN
1675	62-16	SCHAFER/ASPREY	WITCOMBE	116 m	2 H 24 MIN
1676	62-19	HEIN/ASPREY	CHAMBERS	085 m	2 H 15 MIN
1677	62-20	SCHAFER/SYVITSKI	TAYLOR	091 m	2 H 30 MIN
1678	62-21	GILBERT/HODGE	TAYLOR	162 m	1 H 23 MIN
1679	62-22	SYVITSKI/SCHAFER	WITCOMBE	393 m	3 H 23 MIN
1680	62-23	HEIN/HODGE	WITCOMBE	278 m	2 H 44 MIN
1681	62-25	SCHAFER/GILBERT	CHAMBERS	182 m	1 H 42 MIN
1682	62-27	SYVITSKI/HODGE	CHAMBERS	256 m	2 H 06 MIN
1683	62-28	SYVITSKI/ASPREY	TAYLOR	183 m	2 H 25 MIN
1684	62-29	SCHAFER/HEIN	TAYLOR	417 m	2 H 43 MIN
1685	62-31	SCHAFER/GILBERT	WITCOMBE	280 m ?	2 H 00 MIN

Table 2. CTD Station information

DATE	TIME	LATITUDE	LONGITUDE	CTD TAPE	SALIN #
05-09-85	1900 ADT	66 36.9 N	61 54.2 W		
06-09-85	1549 ADT	67 14.3 N	64 23.0 W	#1	10603-10m
07-09-85	0945 ADT	67 12.6 N	64 46.0 W	#2	10604-10m
08-09-85	2210 ADT	67 19.5 N	64 34.3 W	#3	10614-10m
					10615-140m
14-09-85	1312 ADT	69 19.4 N	68 46.3 W	#4	10616 -BOT
					10617-MID
					10618-SURF
16-09-85	1530 ADT	69 32.9 N	69 47.5 W	#5	10619 - BOT
					10620-SURF
17-09-85	1740 ADT	69 36.8 N	68 35.0 W	#6	10501-590m
					10502-10m

Table 3. FLOC camera station information

LATITUDE	LONGITUDE	DATE	TIME	START DEPTH	FINISH DEPTH
66 36.9 N	61 54.2 W	05-09-85	1900 ADT	10 m	190 m
67 14.6 N	64 36.2 W	07-09-85	1930 ADT	10 m	200 m
67 19.5 N	64 34.3 W	08-09-85	2200 ADT	10 m	150 m
69 19.4 N	68 46.3 W	14-09-85	1245 ADT	10 m	200 m
69 32.9 N	69 47.5 W	16-09-85	1500 ADT	10 m	190 m

Table 4. Core station information

STATION NUMBER	FIORD	LATITUDE	LONGITUDE	WATER DEPTH	DATE	LENGTH
SU-0.3	SUNNESHINE	66 36.9' N	62 03.7'W	256 m	05-09-85	158 cm
CO-0.1A	CORONATION	67 12.6' N	64 46.0" W	155 m	07-09-85	240 cm
CO-0.1	CORONATION	67 12.6' N	64 46.0' W	152 m	07-09-85	261 cm
MA-2.1	MAKTAK	67 19.6' N	64 32.3' W	242 m	08-09-85	268 cm
MA-1.1A	MAKTAK	N of ST. MA 1.1B		91 m	08-09-85	256 cm
MA-1.1B	MAKTAK	67 21.6' N	64 46.4' W	107 m	08-09-85	262 cm
MA-1.1D	MAKTAK	S of ST. MA 1.1B		97 m	08-09-85	210 cm
62-20A	ITIRBILUNG	69 16.5 N	69 15.0 W	091 m	13-09-85	146 cm
62-20B	ITIRBILUNG	69 16.4 N	69 14.3 W	091 m	13-09-85	113 cm
62-20D	ITIRBILUNG	69 16.6 N	69 15.6 W	085 m	13-09-85	047 cm
MC-35A	MCBETH	69 32.9 N	69 47.5 W	?320 m	16-09-85	036 cm
MC-35B	MCBETH	69 32.9 N	69 47.5 W	?320 m	16-09-85	074 cm

Table 4. (cont.)

NUMBER:	NOTES ON CORE SAMPLING
SU-0.3	
CO-0.1A	Very soft grey mud, some scattered pebbles at top of core
CO-0.1	top washed out of core on capping; grab sample C0-0.1B
MA-2.1	top of core bagged in two sections: grab sample MA 2-1 = sample between core barrel and weights; grab sample MA 2.1 lower part of core top = upper 30 cm of core very plastic reddish brown silty mud
MA-1.1A	2 cables off north wall; light grey clay
MA-1.1B	4 cables off north wall
MA-1.1C	all attempts failed; water depths 117M, 127M, 122M. material sandy; drop heights 5M, 5M, 12M
MA-1.1D	2 cables off south wall at head of fjord; very clayey
62-20A	#2 OF 4 in a transect
62-20B	#3 OF 4 in a transect
62-20C	#4 OF 4 in a transect -- two attempts failed
62-20D	#1 OF 4 in a transect
MC-35A	triple Lehigh near head of McBeth at Fix 35.5
MC-35B	triple Lehigh near head of McBeth at Fix 35.5
MCa35C	triple Lehigh near head of McBeth at Fix 35.5

Table 5. Station information on miscellaneous samples

LATITUDE	LONGITUDE	DATE	TIME	NOTES
66 36.0 N	62 03.0 W	05-09-85	1000 ADT	four spoon samples of sediment collected at low tide in intertidal zone; SU-2A: Fucus sample SU-3A: middle to upper intertidal zone SU-4A: mid intertidal SU-5A: intertidal S of dive transect 65-3
67 21.1 N	65 48.0 W	08-098-85	1000 ADT	three intertidal sediment samples at head of Maktak MA-1C: UPPER INTERTIDAL MA-1B: MID INTERTIDAL MA-1A:LOWER INTERTIDAL

Coronation land party: wind blown sand

Maktak land Party: #1: stoss of dune #2:sea-side of river cut through dune #3:lee of dune

DIVE 62-12 bivalve shell collected from seabottom; about 3/4 way along dive; on a sloping gradient

DIVE 62-1 Sunneshine sill; micaceous dark sand

DIVE 62-6 Coronation Fiord: brown silty mud

SAMPLE #: TI - 1

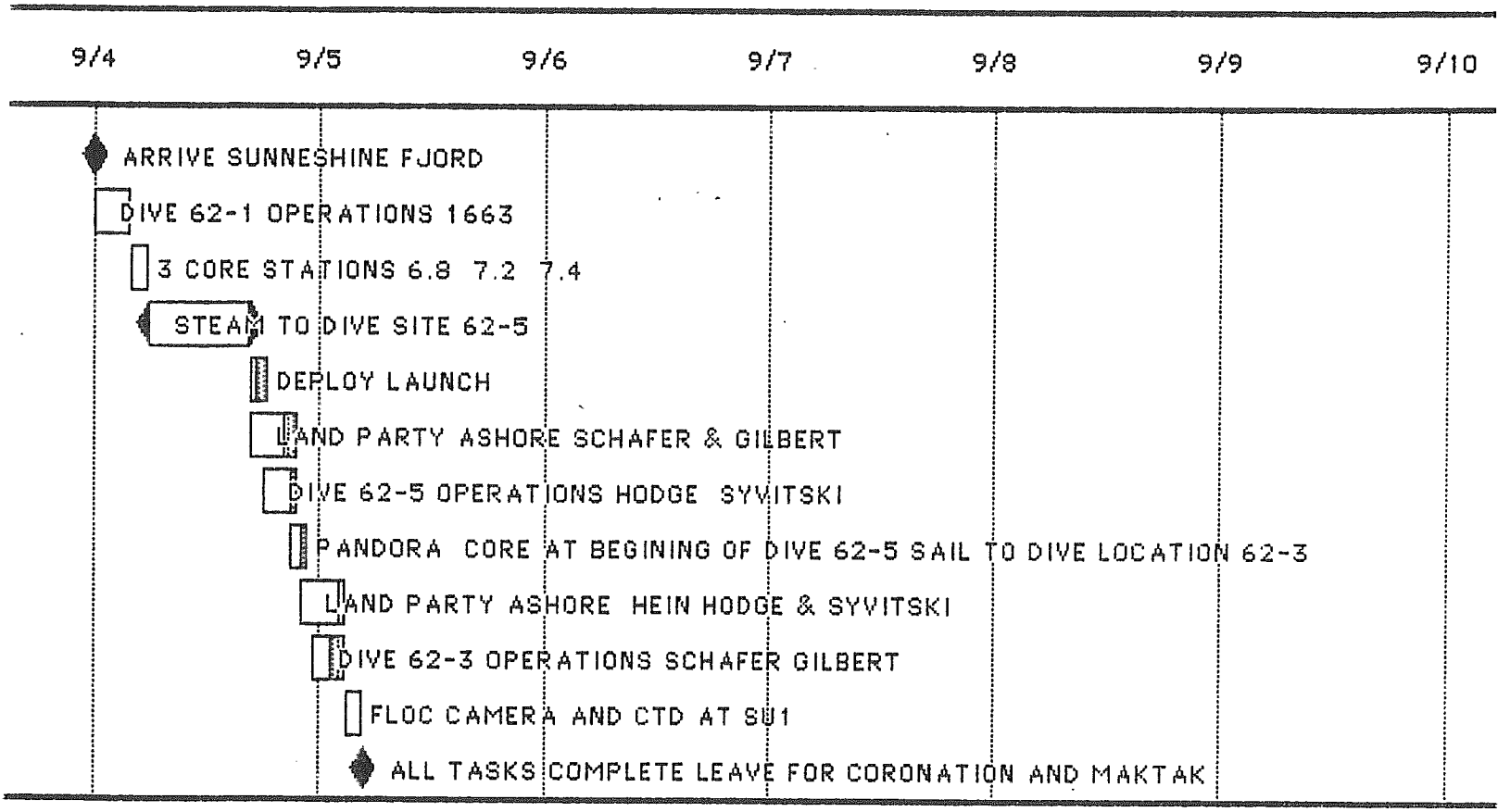
13-09-85 Itirbilung delta: 2 grab samples of micaceous sand from delta top very plastic with high water content; easily folded upon loading

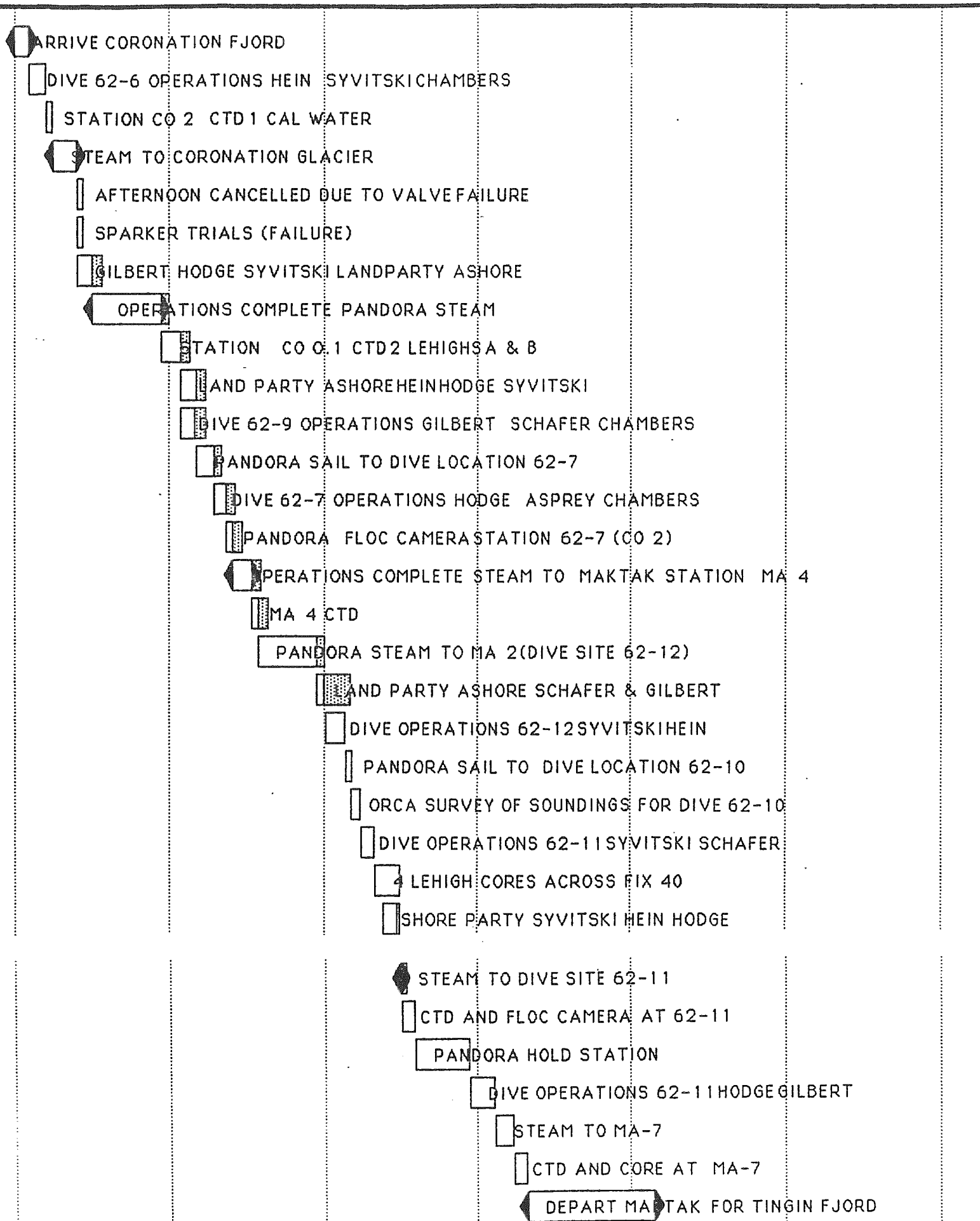
69 15.6 N 68 04.5 W 14-09-85 3 rocks about 1/2 way along dive 62-23, dive # 1680; sample from reworked basal till

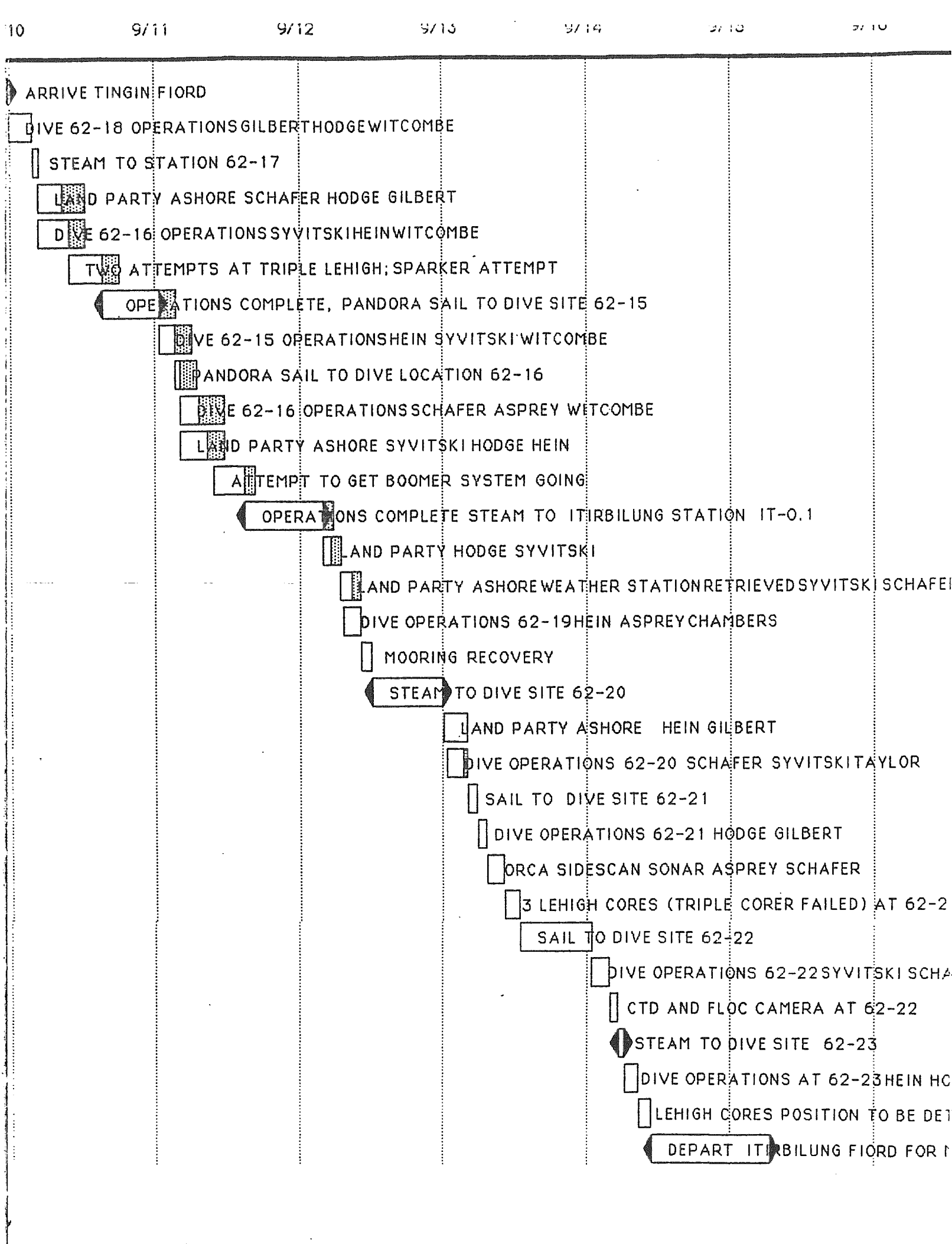
Table 6. Station information on Pisces cores

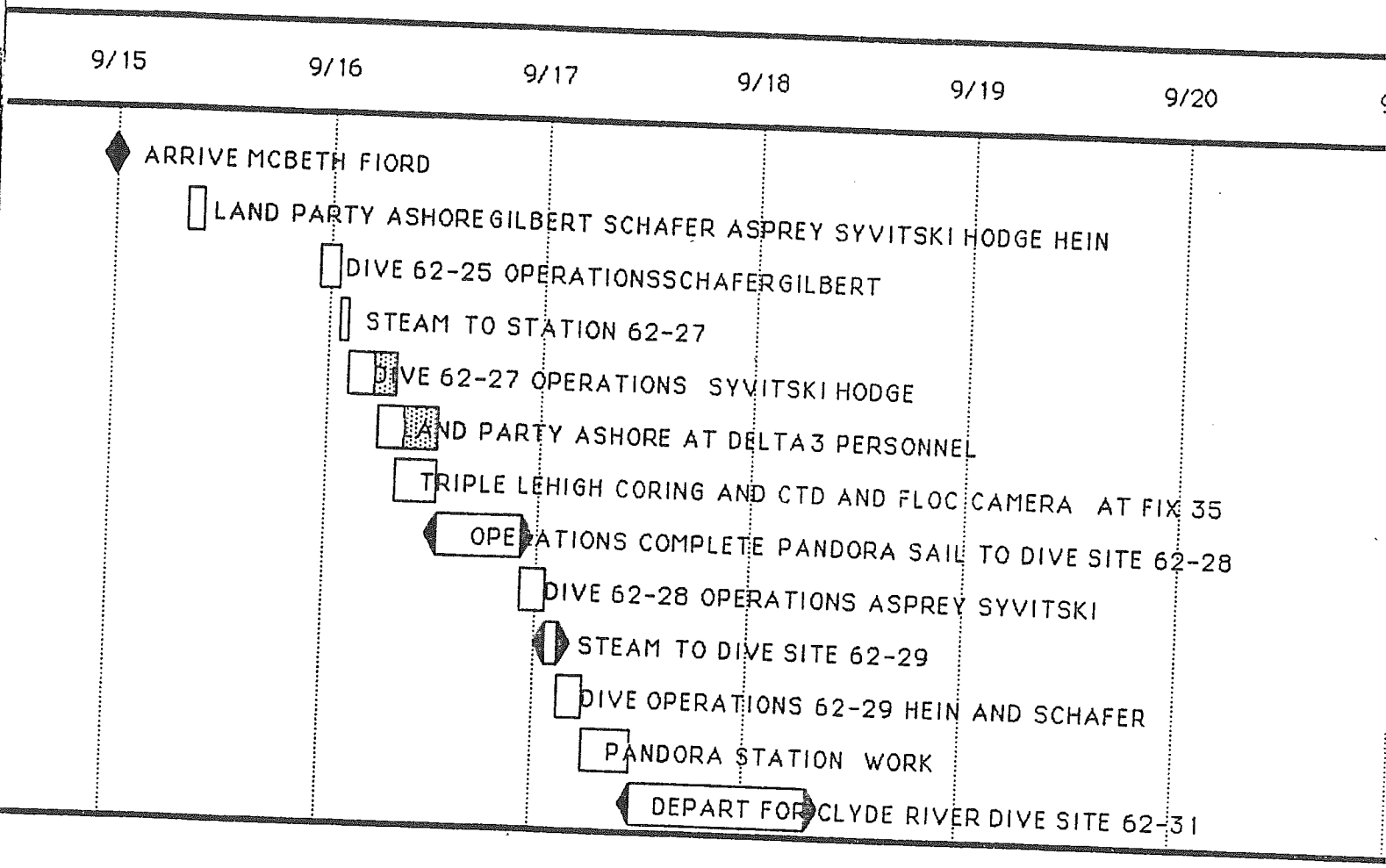
DATE	DIVE #		LOCATION	CORE #	NOTES
16-09-85	1681	62-25	McBeth	1681-1	core
14-09-85	1679	62-22	Itirbilung	1679-1	core
12-09-85	1676	62-19	Itirbilung	62-19-1,2,3	1&2 saved as grab
11-09-85	1675	62-16	Tingin	1675-1	saved as grab
10-09-85	1672	62-17	Tingin	1672-1,2,3	cores
09-09-85	1671	62-11	Maktak	62-11-1,2,3	1 saved as grab
07-09-85	1667	62-9	Coronation	62-9-1	core

The following diagramatic tables documents the agenda of various tasks on the cruise, starting with the general program and followed with detailed information on each of the fjord systems. Stippled boxes indicate that more than one task was conducted simultaneously.

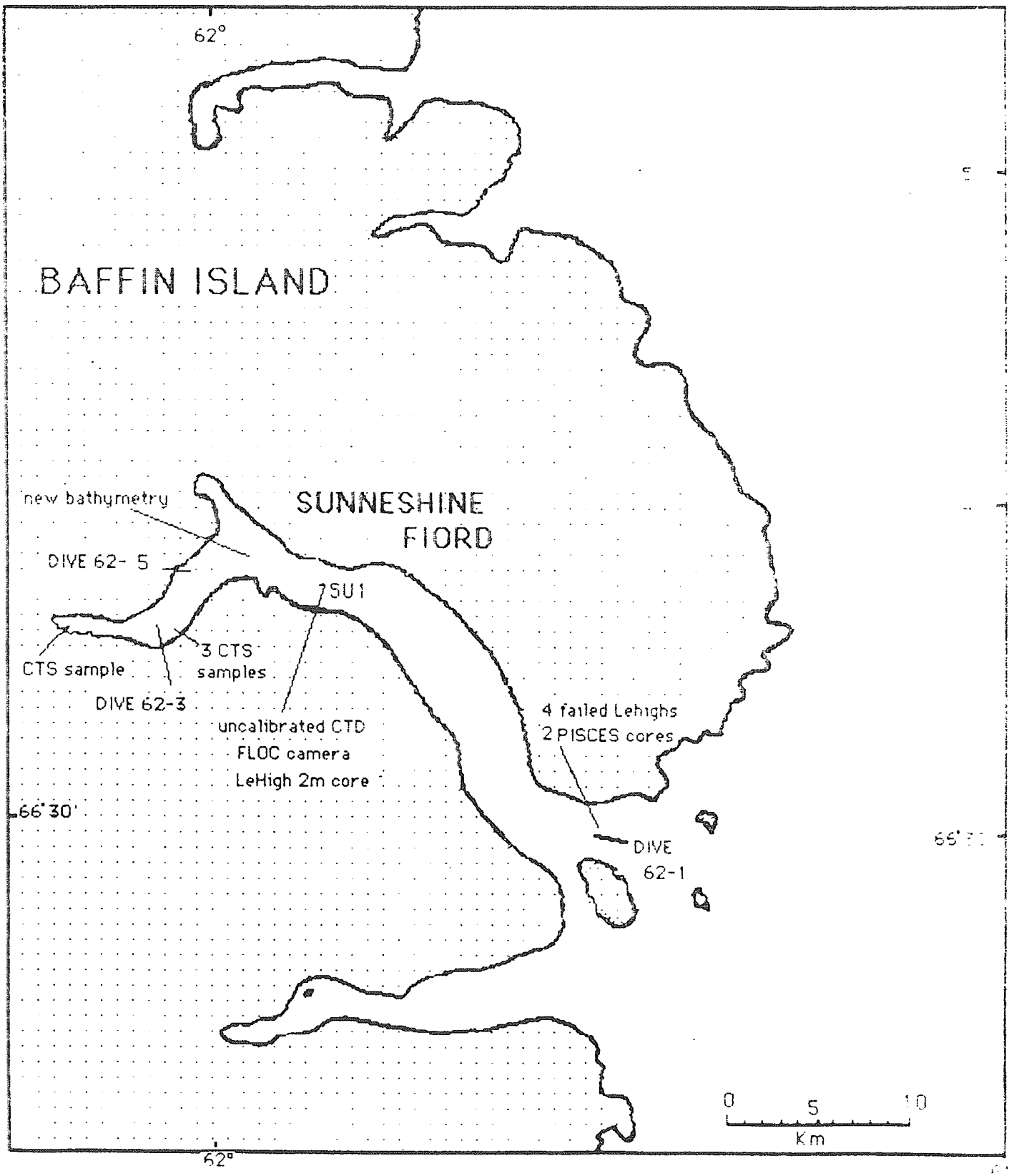

9/4
9/5
9/6
9/7
9/8
9/9
9/10
ARRIVE SUNNESHINE FJORD
DIVE 62-1 OPERATIONS 1663
3 CORE STATIONS 6.8 7.2 7.4
STEAM TO DIVE SITE 62-5
DEPLOY LAUNCH
LAND PARTY ASHORE SCHAFER & GILBERT
DIVE 62-5 OPERATIONS HODGE SYVITSKI
PANDORA CORE AT BEGINING OF DIVE 62-5 SAIL TO DIVE LOCATION 62-3
LAND PARTY ASHORE HEIN HODGE & SYVITSKI
DIVE 62-3 OPERATIONS SCHAFER GILBERT
FLOC CAMERA AND CTD AT SU1
ALL TASKS COMPLETE LEAVE FOR CORONATION AND MAKTAK


9/6
9/7
9/8
9/9
9/10
9/11
9/12
ARRIVE CORONATION FJORD
DIVE 62-6 OPERATIONS HEIN SYVITSKI CHAMBERS
STATION CO 2 CTD 1 CAL WATER
STEAM TO CORONATION GLACIER
AFTERNOON CANCELLED DUE TO VALVE FAILURE
SPARKER TRIALS (FAILURE)
GILBERT HODGE SYVITSKI LANDPARTY ASHORE
OPERATIONS COMPLETE PANDORA STEAM
STATION CO 0.1 CTD 2 LEHIGHS A & B
LAND PARTY ASHORE HEIN HODGE SYVITSKI
DIVE 62-9 OPERATIONS GILBERT SCHAFER CHAMBERS
PANDORA SAIL TO DIVE LOCATION 62-7
DIVE 62-7 OPERATIONS HODGE ASPREY CHAMBERS
PANDORA FLOC CAMERA STATION 62-7 (CO 2)
OPERATIONS COMPLETE STEAM TO MAKTAK STATION MA 4
MA 4 CTD
PANDORA STEAM TO MA 2 (DIVE SITE 62-12)
LAND PARTY ASHORE SCHAFER & GILBERT
DIVE OPERATIONS 62-12 SYVITSKI HEIN
PANDORA SAIL TO DIVE LOCATION 62-10
ORCA SURVEY OF SOUNDINGS FOR DIVE 62-10
DIVE OPERATIONS 62-11 SYVITSKI SCHAFER
4 LEHIGH CORES ACROSS FIX 40
SHORE PARTY SYVITSKI HEIN HODGE
STEAM TO DIVE SITE 62-11
CTD AND FLOC CAMERA AT 62-11
PANDORA HOLD STATION
DIVE OPERATIONS 62-11 HODGE GILBERT
STEAM TO MA-7
CTD AND CORE AT MA-7
DEPART MAKTAK FOR TINGIN FJORD


10
9/11
9/12
ARRIVE TINGIN FIORD
DIVE 62-18 OPERATIONS GILBERT HODGE WITCOMBE
STEAM TO STATION 62-17
LAND PARTY ASHORE SCHAFER HODGE GILBERT
DIVE 62-16 OPERATIONS SYVITSKI HEIN WITCOMBE
TWO ATTEMPTS AT TRIPLE LEHIGH; SPARKER ATTEMPT
OPERATIONS COMPLETE, PANDORA SAIL TO DIVE SITE 62-15
DIVE 62-15 OPERATIONS HEIN SYVITSKI WITCOMBE
PANDORA SAIL TO DIVE LOCATION 62-16
DIVE 62-16 OPERATIONS SCHAFER ASPREY WETCOMBE
LAND PARTY ASHORE SYVITSKI HODGE HEIN
ATTEMPT TO GET BOOMER SYSTEM GOING
OPERATIONS COMPLETE STEAM TO ITIRBILUNG STATION IT-0.1
LAND PARTY HODGE SYVITSKI
LAND PARTY ASHORE WEATHER STATION RETRIEVED SYVITSKI SCHAFE
DIVE OPERATIONS 62-19 HEIN ASPREY CHAMBERS
MOORING RECOVERY
STEAM TO DIVE SITE 62-20
LAND PARTY ASHORE HEIN GILBERT
DIVE OPERATIONS 62-20 SCHAFER SYVITSKI TAYLOR
SAIL TO DIVE SITE 62-21
DIVE OPERATIONS 62-21 HODGE GILBERT
ORCA SIDESCAN SONAR ASPREY SCHAFER
3 LEHIGH CORES (TRIPLE CORER FAILED) AT 62-2
SAIL TO DIVE SITE 62-22
DIVE OPERATIONS 62-22 SYVITSKI SCHA
CTD AND FLOC CAMERA AT 62-22
STEAM TO DIVE SITE 62-23
DIVE OPERATIONS AT 62-23 HEIN HC
LEHIGH CORES POSITION TO BE DE
DEPART ITIRBILUNG FIORD FOR


9/15
9/16
9/17
9/18
9/19
9/20
ARRIVE MCBETH FIORD
LAND PARTY ASHOREGILBERT SCHAFER ASPREY SYVITSKI HODGE HEIN
DIVE 62-25 OPERATIONSSCHAFERGILBERT
STEAM TO STATION 62-27
DIVE 62-27 OPERATIONS SYVITSKI HODGE
AND PARTY ASHORE AT DELTA 3 PERSONNEL
TRIPLE LEHIGH CORING AND CTD AND FLOC CAMERA AT FIX 35
OPERATIONS COMPLETE PANDORA SAIL TO DIVE SITE 62-28
DIVE 62-28 OPERATIONS ASPREY SYVITSKI
STEAM TO DIVE SITE 62-29
DIVE OPERATIONS 62-29 HEIN AND SCHAFER
PANDORA STATION WORK
DEPART FOR CLYDE RIVER DIVE SITE 62-31

SUNNESHINE FIORD



DIVE 85-062-1:1663 SUNNESHINE SILL
SYVITSKI/SCHAFER/CHAMBERS
SEPT. 4/85 15:30 to 18:25

PISCES dive 1663 was designed to ground truth the 1982 Huntec reflection seismic records on the Sunneshine sill, especially the reflectivity values of the upper 0.5 m of the sea surface (at water depths of 60 to 83 m). The dive track was ≈ NW between HUDSON '82 fixes 7 to 6.4 (200 m south of the Huntec track), followed by a 500 m track perpendicular to the fjord axis, until we reached the DEW line cable). **NOTE: All fauna names at this and other dive sites remain subject to verification.**

We hit the seafloor at 64m. The floor was composed of sandy mud covered with brittle stars (two types of ophiuroids: a small pink variety *Ophiura robusta* and a 2 to 3 times as large white variety *Ophiura sarsi*).These remained the dominant epifaunal species, except on till exposures where epilithics dominated. Other soft bottom epifauna consisted of variable density Macoma, some of variable size Buccinid gastropods, rarer brachiopods, large isopods, *Strongylocentrotus* and sculpins. Infauna consisted of a larger white shell bivalve *Serripes groenlandicum* and annelids. Surface (mobile) polychaetes were not obvious. The sea floor surface initially consisted of a very fine greenish organic-rich layer, except where mud volcanoes protruded the seafloor. There the seafloor was composed of sandier greyish sediment.

The seafloor had patches of till-like material exposed as a lag. Some of the patches were up to 400 m^2 . The gravel-size material was mostly fine grained (a few cm's) although boulders as large as 1 x 3 x 2 m could be found. Many of the large boulders were scoured on both the up and down-fjord side. The scour troughs were filled with shell detritus, mainly paired bivalves. Further along the dive, the kelp detritus (which littered the floor normally) circled these large boulders.

The underwater cable was encountered at the 83m depth. It was mostly exposed, some places scoured and other places covered with a cm of the more mobile sandy mud material. No bedforms were seen on the dive. The microrelief of the dive ranged from a few cm to 10 cm in the areas showing mud volcanoes and 100cm in the till areas. The macro relief was a few meters.

Small "dumps" of gravel seemingly unrelated to underlying deposits were noted about 25% into the dive. These "dumps" are presumed to be recent deposits, based on their low concentration of eplithics compared to the

larger gravel and cobble fields encountered in the later parts of the dive. Many of the large erratics observed on the bottom were subrounded while most of the smaller boulders (30-60 cm diameter) tended to be distinctly angular. They were always marked by attached organisms that resembled hydrozoans and anemones. The two species of brittle stars occupied a slightly cusped surface. Several large amphipods (*Acanthostepheia*?) were observed during the early part of the dive; one was sampled using the manipulator and a short core tube. On the large fields of till? outcrop, numerous cobbles covered by Lithothamnion (red algae), were noted suggesting that these deposits have been exposed to wave generated turbulence for a considerable period of time. Adjacent low-lying areas are covered by fine sand deposits that appear to be rather well sorted. Brown stalked algae fragments litter the bottom in a random pattern and appear to attract a certain thin white colored arthropod that is often seen purched on algal fragments. The telecomunications? cable encountered near the ends of the dive was, on average, about two-thirds buried. It appeared to be about 3 cm in diameter. In general, the visability at the bottom tended to decrease with depth and with distance into the fiord.

In summary, Sunneshine sill is composed of wave and iceberg-reworked sediment ponded between till outcrops of unknown age.

DIVE 85-062-5: 1664 SUNNESHINE ROCKWALL DIVE
HODGE/SYVITSKI/WITCOMBE
SEPT.5, 1985; 09:45 - 1300

The objective of this dive was to investigate the seafloor adjacent to a very steep sidewall away from any local sediment source. The dive began 1.6 km down fjord from two large tidewater glaciers near the head of Sunneshine Fiord. We descended 241 m to the seafloor. During the descent SPM was abundant; euphausiids, oikopleura and copepods were numerous, along with 2 to 3 cm long minnow-like swimmers, some sea gosseberries with two 7 to 12 cm long tentacles. Many other types of zooplankton were also present. With depth more euphausids were evident with less copepods, and a great host of krill, which initially were mistaken for a type of ghost shrimp. Flocs of SPM including 'stringers' were evident. The Pisces ran a NW course roughly perpendicular to the fiord wall so that we could cross the bottom, then climb the wall.

The bottom appeared quite soft and muddy, covered in a fine silty material with some organic (fecal) matter. Brittle stars were ubiquitous and numerous. Anemones (mostly closed), some eel pouts, vertical polychaete

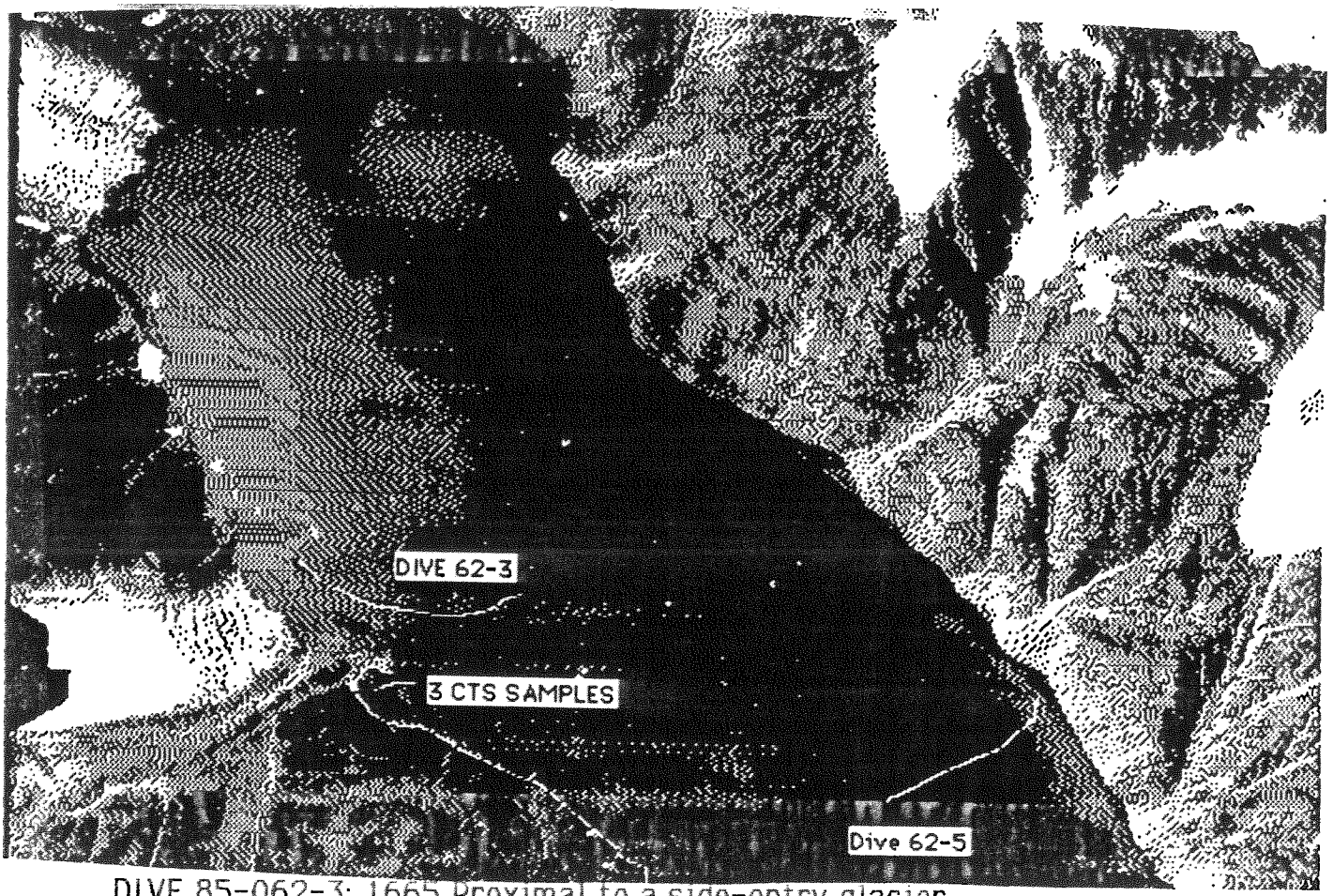
tubes and occasional gastropods were found. Rare isopoods were found throughout the dive. The bottom had 1 metre high by 10 metre long undulations, possibly compression ridges. Occasionally large rocks or boulders (1/2 m high x 1 to 2 m long) were sparsely scattered about. Sponges and occasional crinoid and epilithic anemones were living on the rocks. Brittle stars, worms, centipede-like crawlers, occasional basket stars, eel pouts, isopods and urchins were patchy but common. The sea-floor remained soft and silty, with some organic matter accumulating on the surface.

Closer to the wall, rocks become more numerous and of varying sizes. Small cobbles through to giant boulders (the size of Pisces) were randomly scattered. This could be the toe of a scree slope or a slide, although a layer of sediment overlies all rocks indicating nothing has moved recently. Occasionally shallow furrows (about 10 cm deep x 20 cm wide and 10 m long) were seen (traces of whales ??) and one impact crater was found. The crater could have come from an "ice-transported" rock that was buried on impact, or might have been a feeding trace fossil. Brittle stars dominanted the epifauna life (some were very large (*Ophiuroid giganticus*) although a greater number of sponges and anemones were evident. On some of the largest overhanging boulders, long red-frond hydrozoans were growing only from the undersides of overhangs.

As we climbed the fjord wall, bivalve shell detritus became more common along with purple and red algae, anemones, some laminaria detritus, yellow and white encrusting sponges and other fauna and flora more typical of lower photic zones. The occasional "coon-striped" shrimp, white worm tubes and sea spiders were found.

The submarine talus on the wall was a confused jumble of all rock sizes. Recent rock slides were observed, with rock piles devoid of epilithic growth. Only in a few localities was overconsolidated sediment exposed; showing as areas devoid of infauna. Nearer the upper reaches of the dive shell hash littered the slopes. At 1300, after 3 hours and 7 minutes of diving we surfaced and were retrieved by the Pandora, right off one of two large talus slope fans on the north side of the fiord.

Al Witcombe provided the entertainment and Andreas Vollenweider the music to an interesting and exciting dive. Approximately 70 - 35 mm pictures, and about 15 - 70 mm frames were taken to complement the video. In summary, the talus cones on the fjord walls are continuing to form. These cones may occasionally fail and compress the soft basin mud proximal to the fjord wall.



DIVE 85-062-3: 1665 Proximal to a side-entry glacier
SCHAFER/GILBERT/WITCOMBE
SEPT. 5/85, 14:56 - 16:32

Route: approx 180 degrees from near mid fiord to glacier on south side. This transect started in about the middle of the fiord basin (longitude 62-05W;latitude 66-35.8N) and terminated in about 31 m of water near a submerged moraine. On descent centophores were common; seen every few metres of depth. On bottom at 1515 , 191 metres. The bottom sediment at the start of the dive appeared to be comparatively fine; there was no evidence of bottom currents. Most large boulders had a fine sediment cover and a sparse attached fauna. The sediment below 185 metres supports a dense population of brittle stars and snails. Dense populations of zooplankton (large copepods) are also present below this water depth. their numbers decrease dramatically above 185 m. The bottom topography begins to undulate at about 185 m. The undulations appear to have a relief of about one to two metres and wavelengths ranging from about five to 15 m.

Although the slope near the end of the transect may be steeper than 20 degrees, there was no evidence of slumping or turbidity flows. The boulders encountered at the shallow end of the dive transect (about 31 metres) had diameters of about four metres and were comparable to those observed on the adjacent beach (about 200 m to the southeast).

During the dive, abundant brittle stars covered the sea floor (four species including one very large, ≈15 cm diameter across tentacles; one with "hairy" tentacles). A few cobbles and small boulders were found, most raised about 5 cm above the bottom and covered with a thickness of about 1 cm of mud. The brittle stars were raised about 1 cm off the bottom on their tentacles. Their density was about 1 to 5 per square decimetre. A few attached corals and "feather worms" were found on boulders. Zooplankton were very abundant. Sufficient numbers collected in the lights to obscure the view after a stop of about 2 minutes.

Given below are a few specifics according to time and water depth.
15:30 and 180 m a number of large buccinid gastropods. First 70 mm photo.

15:33 and 172 m Second 70 mm photo. Bottom essentially unchanged..

15:38 and 165 m More of the stones appear to be recently deposited. The first sea urchin is seen

15:38 and 160 m Worm tubes appear in abundance for the first time. They occur in pockets up to about 1 m diameter. Most are partly covered with sediment.

15:40 and 152 m Fewer brittle stars but the condition of the mud appears unchanged

15:42 and 150 m The first Asteroidea appears

15:43 and 145 m more large pebble sized particles appeared on the surface

15:48 sub went over a small ridge and dropped back to 147 m from 143 m at top

15:50 and 146 m A few algal fragments (Laminaria sp.) appear for the first time.

15:52 and 146 m more small stones on the botom. Some almost buried in the mud. Almost none recently deposited, judging by mud cover.

15:55 and 143 m Beginning of a number of irregular undulations, most about 2 to 3 m high, no particular orientation of crests.

16:02 and 139 m third and last 70 mm photo Visibility lower.

16:05 and 130 m beginning of steep slope, sediment character unchanged

16:10 and 118 m many more especially small stones on surface; less organic matter, especially brittle stars.

16:12 and 100 m first crinoid seen

16:14 and 73 m brittle stars down to a few per square metre, with some pockets of more.

16:17 and 32 m large boulders end of dive; sub reverses course.

OVERALL IMPRESSIONS:

Fine sediments predominate on the surface. There is little or no evidence of currents. Drop stones increase upslope toward the glacier, especially pebble sized particles. The zooplankton at all depths and locations are strikingly abundant. There is little or no evidence of slope movement, either of the fine sediments (no large or small slump mounds or scars) or of the large particles (no trails behind or push ridges infront), even though the slope exceeds 20 degrees in some places, especially near to the end of the dive. There is no evidence of gravity flow events (sands or stones carried by turbidity currents, debris flows etc.). There are no small channels cut by such events, and no evidence of bed forms or related features.

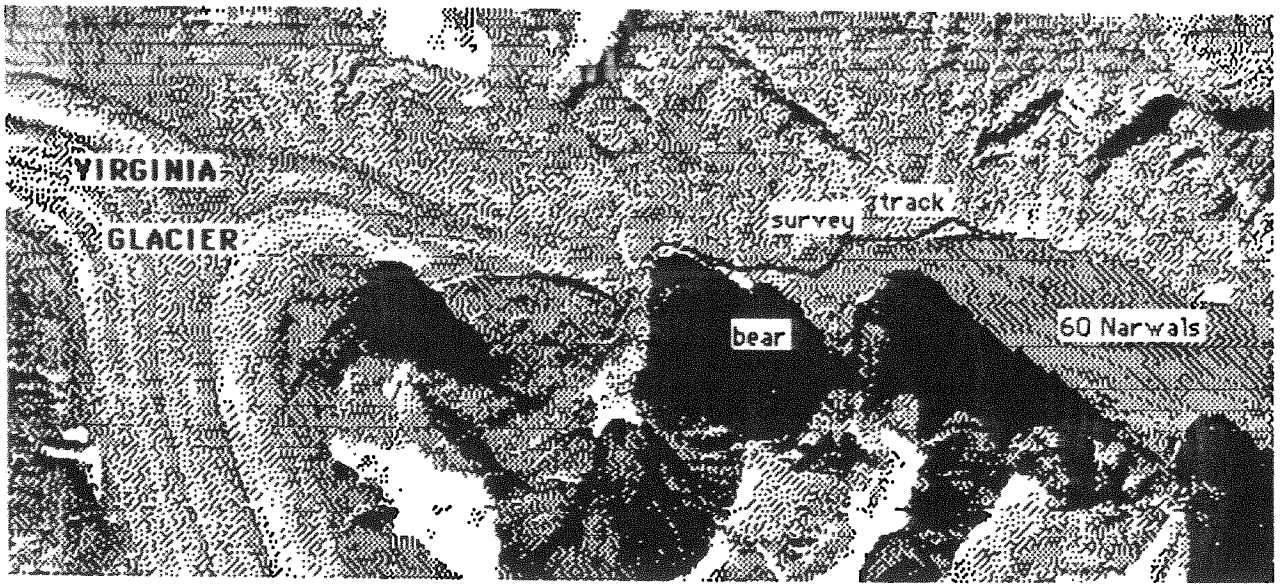
LAND PARTY ASHORE AT HEAD OF SUNNESHINE FIORD.
Hein, Hodge, Syvitski Party
SEPT. 5, 1985.

We landed at low tide on the intertidal flat at the head of Sunneshine Fiord from the Zodiac. Tidal ridges ran parallel to the shoreline and were mainly sandy with a thin coating of silty mud, which showed runoff features such as rill marks and small runoff channels. The area at the head of the bay consisted mainly of side entry input by a small glacier, and a point source from the main valley. Going updelta, one passed from the tidal bar area, to a more braided sandy delta top. The braid plain was mainly sand, coated with a thin veneer of silt (glacial rock flour).

There were unidirectional current ripples down individual braid channels, but along the exposed braid bar tops there were commonly interference ripples, oscillation ripples, runoff rills and small runoff channels -- an obvious tidal influence on the higher braid interchannel areas, and more of a unidirectional current from the stream down the braid channels. About 1/4 the way up the delta area, small local 'pools" of fine to medium size gravel occurred as lags within the braid channels. The sandy and silty braid delta plain rapidly graded up into a gravelly, cobble to boulder, braid plain.

On the gravelly braidplain there were two or three main channels (compared with 4 or 5 down on the sandy delta top). The only surficial features were small (25-30 cm long and 1 pebble wide) transverse ribs in the finer gravel fractions. Water surface slopes were quite pronounced, as was the gradient on the fan-delta surface. Cobbles and boulders were well imbricated, with an a-axis flow-parallel, b-axis upstream imbrication pattern. Topographically higher areas of the braid plain displayed an openwork texture of imbricated cobbles and boulders; whereas in the topographically lower parts of the plain, where channels were active, the coarser cobble and boulder material was being infilled with finer sand and silt. Going further upstream, we encountered a lot of large blocks and boulders (probably a moraine), at which point we went around the big blocks, and up a smaller stream (which had big and little polar bear footprints). Upon emerging the otherside of the obstruction, we again opened up onto a braid plain, just downstream from an icewall on a side-entry valley glacier. The braid plain consisted mainly of two large and flat gravel areas, with a high degree of dissection. The only discernable bedform was transverse ribs in the smaller gravel sizes. Discharge from the glacier was relatively clear. The discharge from Virginia Glacier was apparently ponded in a lake behind the moraine that occurred up-valley from where we stopped.

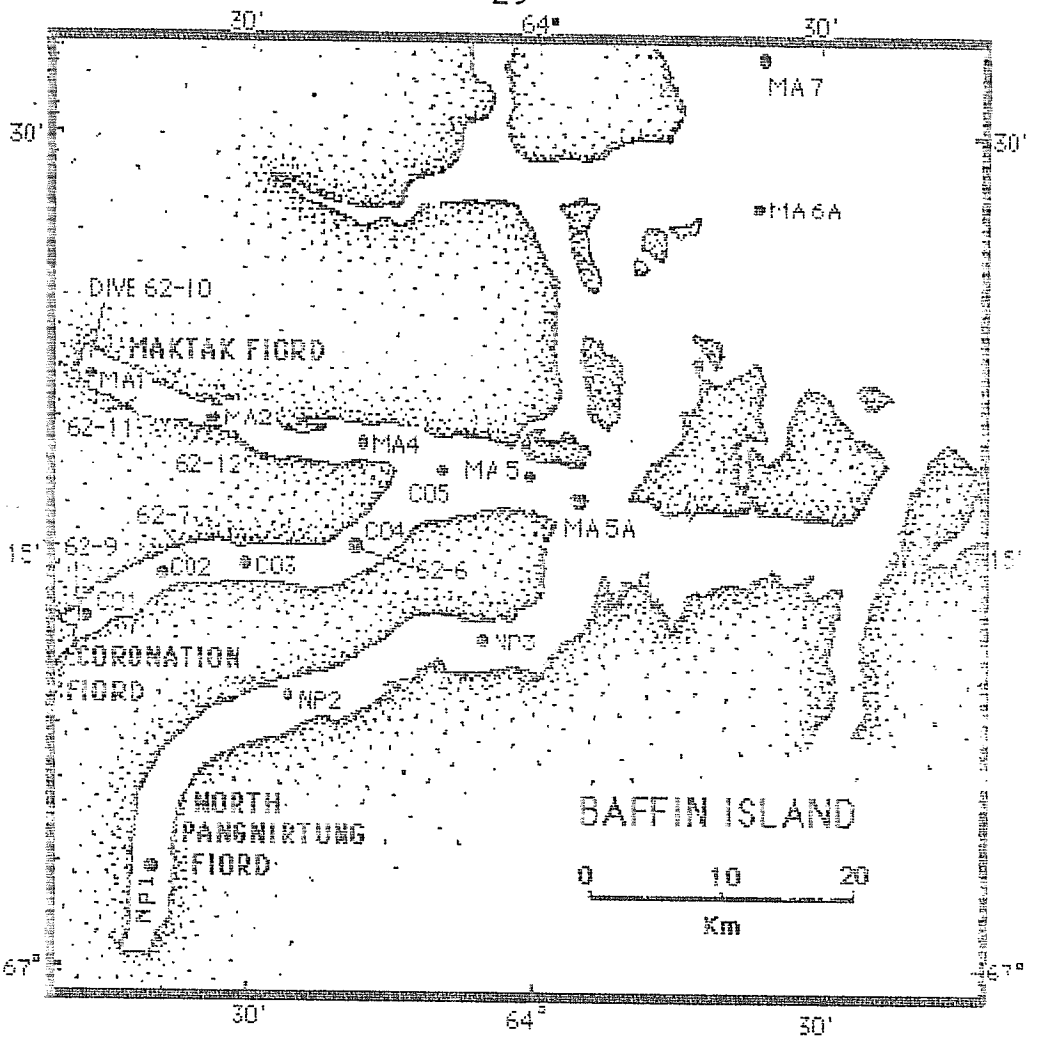
Upon coming back to the inlet to meet the boat, we saw about 2 harp seals, and perhaps 10 pods of whales, each pod containing 6 or 7 whales (totally perhaps 60 - 70 whales). The species is narwhal (*Monodon monoceros*): dark top, which was speckled tan and white, and a white underside. Upon initial entry into the fiord head, we scared a polar bear off the side-entry glacier, that ran up the valley and wasn't seen again.



SUNNESHINE FIORD HEAD

CORONATION FIORD

Coronation Fiord is one of three fjords of Baffin Island dominated by a tidewater glacier flowing into its head. The dive site locations were based on proximity to the icefront and high resolution reflection seismic and side-scan sonar features. The purpose of this suite of dives was to obtain information on the deposition of sediment near a large tidewater glacier and syn- or post-depositional failures within these deposits.



DIVE 85-062-6; 1666 CORONATION DEEP DIVE
HEIN/SYVITSKI/CHAMBERS
SEPT. 6, 1985: 11:33 - 13:37

The purpose of this dive was to describe bottom features of the distal end of a large slide/slump identified from 1982 reflection seismic records. During the descent single flocs of SPM particles dominated the water column; with depth more stringers of organic films with attached particles became common. Some of these stringers floated near-horizontal and ranged in length several cm's. Most hung vertical to slightly oblique orientation in the water. Below are some highlights of our observation.

370 metres: On bottom. Visibility moderate, about 4 metres. The bottom is quite "loose" consisting mainly of silt-size particles, which are easily resuspended, as mainly individual particles, with the slightest disturbance by either the Pisces or a passing fish. A few scatterred eel pouts, retractable white polychaetes and red to orange brittle stars (? *Ophiura*

robusta) were observed.

370 metres, course 320^0: Large angular boulders with attached fauna (branching anemones *?Alcynonacean*) and encrusting epilithics (? bryozoans) were scattered about. Average size of boulders is about 30 cm diameter, all are very angular. Fairly common basket stars on the silty bottom were oriented with fans spreading out to the current. Fan diameters of the basket stars ranged from about 1/3 metre to a maximum of about 1 metres. The average diameter of the basket stars was about 0.5 meters . Under some of the arms of the basket stars are nestled small bottom fish (? gobiids). These small fish are very common -- 5 or 6 per view; are between 5 and 10 cm long; a dark grey in color and in sleeping mode curl their tails around themselves as they nestle in holes in the bottom. Scattered filter-feeding polychaetes (similar to feather duster worms down south) occur as infauna, with an average of about 3 worms per group.4 - 5 cm long gastropods were abundant.

370 meters, about 15 minutes later: scattered polychaetes, orange and red brittle stars (?*Ophiura robusta*), and white branching anemones, which can have 5 or 6 branches per stalk (white in color to grey). Some fatter, white anemones live on gastropods, piggyback, travelling along the seabottom with the gastropod shells. The density of basket stars has increased markedly to 3 or 4 per 2 m^2. Some scattered mobile tube worms (polychaetes) occur. Many small isopods, about 1 - 2.5 cm long, litter the seafloor, and commonly get bowled over with the bow wake from the *Pisces*. Densities of these isopods are very high -- ? 50+ per 2 m^2 . These isopods are white and resemble pill bugs on land. Occassional krill were found. One 2 m+ angular boulder with encrusting and attached fauna. Some "fist-size" (i.e. 4 cm +) diameter sizes holes are very common on the sea floor. Many of these are lined with other holes, which are about 1 cm in diameter, making the interior of the larger holes resembling swiss cheese. Abundant 4 -5 cm long Buccinid gastropods.

368 metres, #3--70 mm camera shot: large angular boulder, 3/4 m long; two large angular boulders, 1 - 2 metres long each. All boulders are very angular and have attached fauna living on the upper sides.

366 meters: Many 2 to 3 m boulders, scattered angular cobbles. Some of the "swiss-cheese" 4 - 5 cm diameter-size holes have tubes inside the smaller holes (perhaps some sort of colonial anemone). Other holes are vacant and infilled with silt-size material. Sometimes other organisms inhabit the vacated holes -- i.e. octopus, the dark grey fish (described previously with the basket star), or brittle stars.

362 meters: Boulder field (Hit). Many scattered angular boulders, some of which only have a coating of silt, with no attached life forms (i.e. fresh). All sizes from cobble to very large boulders.

364 meters: scattered angular boulders, most with attached fauna, including occasional crinoids. Sizable fish, some with white stripes and a dark body. One flatfish (possibly a Greenland turbot or Atlantic halibut) was spotted after the boulder field. Brittle stars are not as abundant.

363 meters: first occurrence of red and white shrimp. The "swiss-cheese, fist-size" holes are quite common, some with up to 10 or 12 embedded smaller holes on the inner walls. So far, 2 octopi, one large starfish, a huge basket starfish (0.5 m diameter) have been seen.

360 meters: scattered sabellid polychaetes and brittle stars. Fairly common are basket stars and the "swiss-cheese, fist-size" holes, many of which have other occupants, including octopus, eel pouts and brittle stars.

360 meters, about 10 more minutes later: very few animals. Scattered brittle stars, sabellid polychaetes. Brittle stars, if present, are probably buried in the sediment. Small reddish brown, thin Amphitrite (about 25 cm long, 2 cm wide) noted. Many "swiss-cheese" holes. Bottom fauna is much more patchy and irregular in its distribution. One large, fat sea cucumber noted. Scattered angular cobbles with attached crinoids, with up to a 30 - 35 cm diameter spread on the fronds. Some epifaunal anemones (short, stubby and white) rolled along against the Pisces bow wave..

362 meters: holothurian (sea cucumber) in a field of angular boulders.

358 meters: lots of fish (? eel pouts or gobiids), two huge angular boulders, with attached crinoids and encrusting bryozoans. Scattered branching anemones (5 or 6 per stalk, white in color, with irregular-length fronds), brittle stars, white stubby anemones, sponge stalk, one echnoid (sea urchin) without noticeable spines, scattered smaller boulders with attached fauna, including branching anemones, crinoids and encrusting bryozoans. Occasional basket star.

Overall this trip was on a very gentle incline, with a maximum of 10 - 20 metres of relief. There did appear to be some rolling topography on the bottom, but of an irregular form and with very little microrelief. As the dive was on the distal end of a large slide/slump (seismostrat. evidence) recent hemipelagic sedimentation has masked all primary-exposed failure features.

SHORE PARTY TO CORONATION ICEFRONT
GILBERT/HODGE/SYVITSKI
Sept. 6, 1985: 17:00 - 21:30

The front of the glacier was surveyed from the ugly boat. We noted that the icefront had retreated from our 1982 survey, especially within the central portion. The southern portion had changed the least. The main underice channel had shifted to the south from the main medial moraine and was seen bubbling up, out some 100m from the icefront. The perched icedammed pond surveyed in 1982 was no longer present with only minor evidence of its presence remaining. Brash ice was found out from the brown zone of icefront upwelling. As we entered the northern lagoon complex, we entered a very active part of the ice front. Boulders, some very large, fell from the sheer ice face that towered some 50m above the sea surface. Also, a large (8m high, 20m across) ice tunnel was approached. Along the entire front, between 6 and 8 major discharge points were observed, in addition to a host of minor rivulets and falls from the ice surface. Each of the discharge points had variable amount of suspended sediment concentrations (30 to 130 mg/L).

As we tied the boat up to a rock on the sandy shore of the medial moraine frontal environment, we commented on water lines and scattered ice blocks many meters above the high high water line (HHWL). We noted that these must result from wave wash up of "taqsaq" or iceberg generated waves. We climbed the complex of ice cored ridges protected from melting by the deposit of esker and windblown sand and morainal rock blocks (some 8-10m in diameter). The aeolian sand was 1 to 2 m thick plastered on the stoss side and tops of these ice cored ridges. While we were at the top of the complex, one of the larger icebergs in the lagoon overturned. The berg was about 80m in diameter at the surface. The overturning was extremely violent lifting thousands of gallons some 50m's in the air, temporarily creating a water fall. Three large waves were generated from the berg overturning and these were observed travelling down the fjord at high speeds. Two consequences of these waves were to lift our ugly boat high onto the shore and to clear some of the bergy bits out of the lagoon and into the fjord proper.

DIVE 85-062-9: 1667 CORONATION ICE FRONT
SCHAFER/GILBER/CHAMBERS
SEPT. 7, 1985: 10:30--13:30

The dive was carried out near the face of Coronation glacier starting at a depth of about 92 m and continuing inshore to a depth of 35 m. Previous side scan and HUNTEC reflection seismic surveys show a complex pattern of hummock features seaward of the calving glacier face. The hummocks (about 1-3 m high) were encountered several times along the transect. Their axial directions varied considerably as suggested by side scan data. Their tops were rounded and composed of fine sediment of unknown thickness-there was no indication of larger clasts in the fine matrix during the many contacts of the PISCES skids with the bottom. Typical slopes appeared to range from 10 to 40? degrees and some seemed to reach between 60 to 70 degrees. The steeper slopes may represent the walls of turbidity channels or isolated slump scarps.

During the decent, the grain size of the SPM decreased from floc sizes near the surface (~1.0 mm) to silt and finer diameters near the bottom. Both the coarse and the fine SPM showed a homogeneous distribution with no evidence of stringers or clumping. Very few zooplankton were noted in the upper 30-40 m of water. Near the bottom, small (0.5 cm long) copepods made their appearance but were few in number. Visibility at this point was about 1.0-1.5 m.

The bottom fauna at ~92 m consisted of moderate to low numbers of brittle stars that made distinctive tracks (up to 0.5 cm deep) over the bottom; snails were also common but no attached invertebrate species were observed. Polycheate worms and bivalves (Macoma sp.) were noted starting at about 50 m and appeared to parallel a change to coarser (i.e.,less clayey sediment). The high clay content of the sediment observed at the start of the dive is suggested by the 5/6 burial of a Gilbert pool ball (the Gilbert pool ball test for sediment strength) as opposed to only about a 1/3 burial in sediments tested at about 40 m depth.

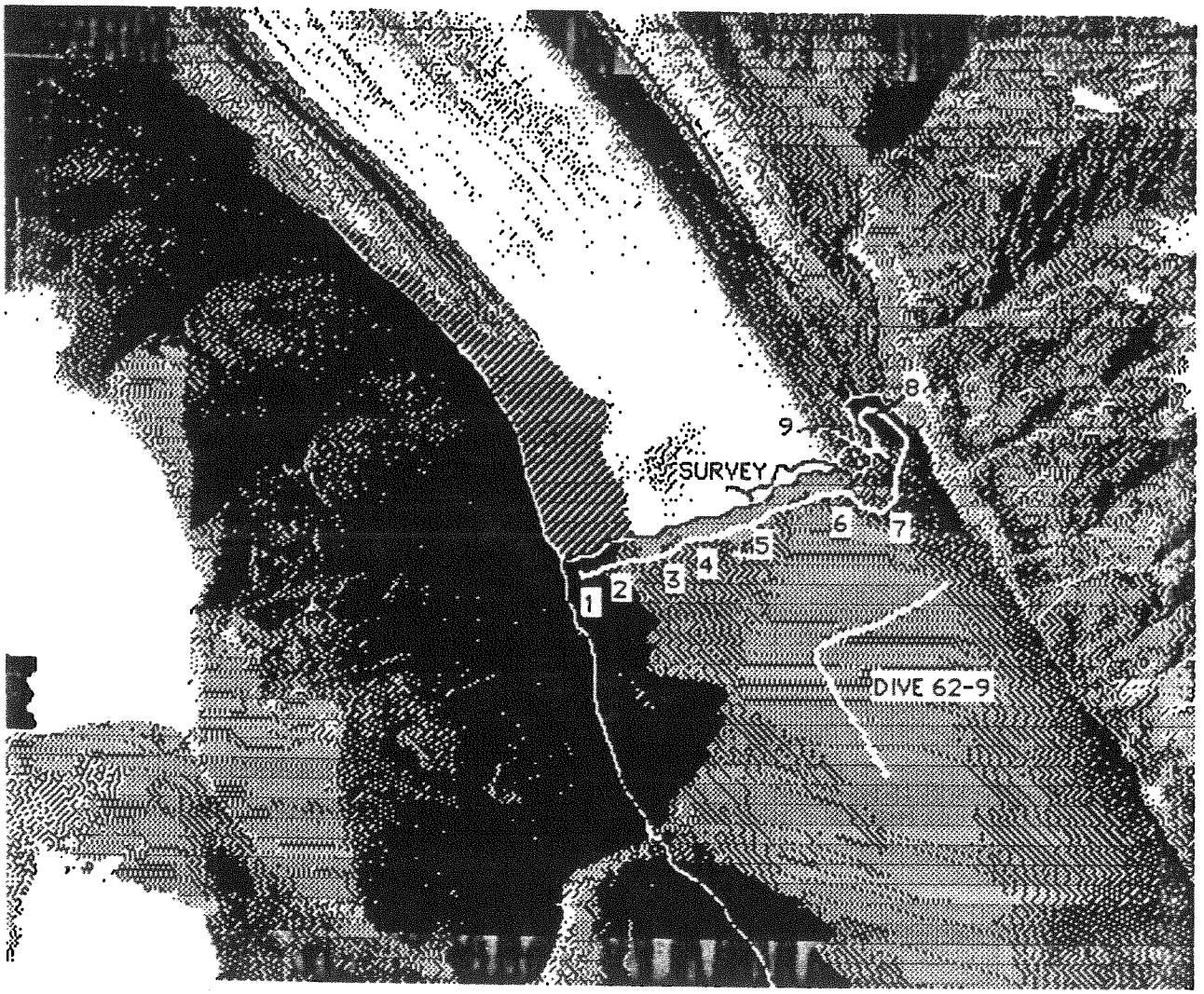
Detailed observations from video tapes:

Observed relatively high sediment concentration especially in first 50 metres, suspended sediment appears sterile. Copepods appear below about 40 m, and sediment concentration decreases somewhat.

70 mm photo (#1) on first sight of bottom at 92 m about 1105. Bottom very soft, no current evident, brittle stars dominate, trails to 5 mm deep. Most are raised off the bottom up to 1 cm, tentacles down into mud to 1 cm

(indicating depth of bioturbation from stars).
70 mm photo #2 at 90 m and 11:19
70 mm photo #3 at 90 m and 11:22
Begin to encounter hilly terrain at about 80 m and 11:25
70 mm photo #4 at 11:27.5
Small centophore seen in water column. Several others seen during the next 30 minutes.
11:35 to 11:38 in about 70 m depth first ball drop experiments (668 on tape counter).
11:43 and about 75 m core recovered.
Moving over similar very soft bottom with irregular steep hills about 5 m high. Sub sets off small turbidity current on striking the bottom at about 11:48.
70 mm photo #5 about 11:50
70 mm photo #6 about 11:52 just after goind over very steep ridges.
Bottom similar but more siphon holes visible. About 60 m and 11:55 "feather worm" tubes start to appear, each about 5 cm high.
70 mm photo #7 just over sharp crest of steep hill. at 52 m and bout 11:56.
From 11:57 to the end of tape at 12:29 most of the time was spent in the series of steep hills, off the bottom (only occassional looks at the bottom). Considerable time trying to line up the ball for drop experiment)

Second tape: starts with drop balls. three tries with the same ball: the first just off screen, the second sinks in about one third, the third in about one quarter, a small crater associated with each.
moving off at 37 m and 12:37 "feather worms" are more dense.
70 mm #7 at 35 m and about 12:39, course now about north. about 12:40 more gastropods on the bottom.
36 m depth third drop experiment. Two drops, each about one third way into sediment. Attempt to recover a second core not successful when core falls out of tube. Return to surface shortly after.



SHORE PARTY TO CORONATION ICE FRONT
SYVITSKI, HODGE AND HEIN
SEPT. 7, 1985: 11:00 - 13:30

We took the ugly boat and cruised from south to north, approximately 250 m offshore of the glacier front, sampling water along the front. Nine surface water samples were taken from sites corresponding to varying turbidity of the water. Approximately half-way along the glacier front there was a major zone of surface turbulence, with a counter-clockwise circulating gyre and bubbling up of turbid (tan colored) glacial water (Sample #W-4). The turbidity contrast was remarkable between the ambient seawater and the fresh glacial water influx. There were numerous falling boulders and small outlet waterfalls cascading from the front of the glacier. Ice at the front is highly crevassed, with deep fractures

running parallel to the ice front. Much of the ice front is steeply overhanging, with 2 or three major caverns at the front of the glacier. The ice at the south side of the glacier front is black ice, but extending from about 1/3 the way up from the southern edge, the ice is a lighter blue and white.

We landed at a small "lagoon" on the north side of the glacier, which is flanked on one side by the fiord wall and the other by a medial moraine. Upon landing, Syvitski and Hodge noted that the beach ridges which were present yesterday (6 Sept. 1985) were now gone. All that was on the beach was a boulder strewn patch; the area between the boulders being infilled with coarse-to-granule size sand and pea size gravel. Some of the boulders were imbricated, and all are very angular. Wash marks in the sand were from west to east, and a large iceberg apparently had rotated 180 degrees during the night, creating a significant bow wave that erased the beach ridges. There was only plane bed in the sand and swash marks -- no rippled surfaces on the beach.

About 5-10 meters to the south is the ice-cored edge of the medial moraine, which is a very jumbled mixture of sand, rock flour and boulders. The unconsolidated sediment is piled high into a sharp ridge, which is faulted (faults dipping to the west), and has very steep surfaces (near vertical). Numerous small debris flows, rill wash, and small sandy alluvial fans are forming as resedimentation of the morainal material. There is quite a bit of relief on the pile of sediment -- various smaller peaks, which are perhaps 15 - 20 m high (?). Most of the sediment pile is ice cored -- reaching the top of one of the silty/cobbly piles, we looked over the crest and were able to see ice, that was faulted, with sheets (similiar to exfoliation sheets) dipping to the southwest at near vertical angles. Further to the west, the morainal debris is very coarse cobble/boulder-size material, which again is ice-cored. There is a patchy covering of dark brown pellets of silt size material on the ice top.

Climbing up onto the ice margin, we passed a few huge (10m+) boulders, and climbed a fair distance (? 30 m) vertically up the ice front to the top of the glacier. On the surface of the glacier there were small meandering meltout channels, small ponds and lakes, some of which were carrying fine-gravel to silt size material (usually fine sand/silt). The channels were highly meandering across the ice surface, with the resedimented material forming mini-point bars, or little alluvial fans and braid channels. Dimensions of these small surficial streams varied from 10's cm

to about 0.5 to 1 m across, and a few cm to ? 0.3 m deep. The surface of the ice was surprisingly rough, being very pitted and irregular -- it is obviously melting back because there are numerous solution holes and pockets on the surface. At the top of the ice along the northern margin, as one looks "upglacier" there are numerous randomly scattered boulders.

We traversed the ice margin top about half-way along the glacier-front to a point just north of the large "cave" about midway across the glacier front. We walked out near the overhanging edge, crossing several large crevasses which were about 0.5 m wide, traversing the entire front of the ice margin. There were smaller conjugate sets of crevasses running at about a 45 degree angle to the major ones running parallel to the ice front. There was active movement on many of the major crevasses - perhaps one creak & groan about every ten to fifteen minutes. Motion was felt at one point when we were near the edge.

Some of the spalling ice sheets were very loosely attached , with a steep overhang from the major crevasse -- with the sheet dipping off the ice front at about a 15 to 20 degree angle from the vertical. Many englacial and subglacial streams were pouring beneath us -- with a rushing torrent of water. Occasional large boulders could be heard falling into the water. All in all a very active margin.

Other Notes:
Aside from the morainal areas, most of the ice surface is relatively clean of debris aside from the scattered boulders, and small pellets or fines in the surficial pools and streams.

Puddles of pellets occur on the ice surface. Some were angular, more commonly rounded -- a 1/16 to 1/8 inch in diameter. They are fairly loose and easily disaggregated . The pellets are comprised of silt size material.

DIVE 85-062-7:1668 CORONATION FIORD
HODGE/ASPREY/CHAMBERS
SEPT. 7, 1985: 15:55-18:00

This dive was situated mid-fjord and thus provided an intermediary site between dives 62-6 and 62-9. Our purpose was to document any transitional facies between these two end members. Pisces launched at 1600 hrs. Descent was rapid for 200 m making observation and identification of zooplankton difficult. The water column was heavily

loaded with SPM, finer sizes near the surface and larger sizes or flocs toward the bottom. The last 50 m of descent was at a comfortable viewing speed, and copepods, euphausids and other zooplankton were seen. Stringers of SPM were also seen, though not abundant. Jelly fish were more common in lower depths. Krill in small density, probably attracted to the lights, greeted us at the bottom.

The bottom appeared flat; a light brown murky muddy silt, with a very soft top layer (only a few centimetres thick). Pisces sat down, did not sink, but stirred up quite a turbidity cloud on lift off. Brittle stars both large and small were very common, particularly *Robusta*. Sea urchins, eel pouts, polychaetes, the occasional gastropod, and some, mostly closed, anenomes, along with a few small sun-stars and shrimp made up the fauna of the floor. Rocks, varying in size from large cobbles to pieces 0.4 m square were sparsely scattered throughout and all were well dusted with silt.

We ran approx. 700 m (according to ship tracking) along the fjord axis, then turned 90 degrees to run a profile to the south side wall. The bottom seemed flat and rising gently to 213 m where we encountered rock debris (flow? or scree slope toe?) which we hit! We climbed the rock slope for 50 m into what appeared to be a slide chute. The rock debris fined upwards; the fragments near the top were fist sized, those at the bottom ranged up in size to boulders half the size of Pisces. All material was angular and covered with a centimeter or two of sediment. There was virtually no life forms here, save the occasional shrimp, urchin or wayward fish.

We climbed out of the chute onto a crest of a ridge, heavily silted, quite steep but showing no evidence of slippage of failure and only occasionally could parts of rocks be seen. Our ascent took us back and forth across the ridge, approx. 30 to 40 m wide. Twice, we may have encountered bedrock, but in general, mostly smaller and potentially mobile rocks were found.

Sedimentation continued to be relatively heavy. 3-4 species of brittle stars, a branching, self-supporting (approx. 0.5m tall) tree-like anenome, gastropods (and their tracks), polychaetes and urchins were seen; typical of variety and distribution of the fauna at depth in the fjord. Occasionally, where there was overhanging rock providing protection from the sedimentation fallout, sponges and other less mobile life forms were seen.

Our ascent continued to follow the ridge crest. At about 50-55 m we were back into rock debris. Serpulid worm tubes began to appear. By 35 m red algae could be seen under rocks. Laminaria detritus was more abundant. Sedimentaion rates continued to be very high with more floculation than was evident at the centre of the fjord. We left the bottom at 15 m, and were recovered and back on deck by 18:30 hrs.

2 video tapes were used on the dive, approx. 10 - 70mm pictures were exposed, and approx. 20 - 35mm pictures were taken. The observers were glad to be able to assist with rock-spotting and interpreting radio messages, helping to make the dive interesting and fun.

MAKTAK FIORD

DIVE 85-062-12: 1669 MAKTAK MIDFIORD DIVE
69° 31.2' N; 64 ° 32.1'W
HEIN/SYVITSKI/TAYLOR
Sept. 4, 1985 09:27 to 11:30

Our transit was up the center of the inlet (≈ 1 km), followed by a right turn towards the side-wall where we climbed a hummocky topography at base of slope and finally the steep side-wall slope. Our principal objective was to ground truth an extremely chaotic (with acoustic hyperbolics) reflection seismic structure along the seafloor: is it a bedrock outcrop? till? slide or slump feature?

We began our dive at 09:30 and noted that *Oikoplura* became increasingly abundant towards bottom, with a variety of sizes to the tests. Zooplankton activity also increased with copepods and euphausiids becoming common. There is more dead gelatinous material towards the seafloor. Stringer intensity has increased, although they are small (cm or two across) and coated with small SPM. At 200 m - *Okioplura* still common. Stringers increasing. 206 m - tape stopped

246 m - On bottom. Few brittle stars *Ophiura robusta* and *Ophiura giganticus* (medium and large size varieties) ; *Alcyonacean* (' branching anemones'); and small (2 - 3 cm long) isopods on the bottom. Visibility 3 - 4 meters. Few 10's cm wide diameter Swiss-cheese burrows occur. Scattered white retractable polychaetes and shell debris. Small mounds (~ 10 cm high) of possible fecal pellets, reworked or disaggregated. Anemones growing on Buccinid gastropods. Visibility decreased to 1 -2 meters. Abundant SPM. Increasing seafloor gradient. Octopus sighted.

245 m Basin-and-dome topography, resembling hummocks. Anemones occur on the heights of the domes (which have ~ 1 - 2 m relief from the adjacent basin). Scattered red starfish; isolated cobbles in the basins. These are fresh (i.e. no attached epilithic fauna) and silt-covered.
course 280^0 - Highly undulating topography. Becomes a quite rolling dome- and-basin seascape. Isolated cobbles. Scattered Buccinid gastropods; isolated fecal mounds. Few brittle stars. Large trace marks left by Buccinid gastropods. Some anemones growing on the gastropods. More abundant retractable white polychaetes. Rolling topography resembling "Badlands of Alberta" . Some slopes are bare; others show a

patchy distribution of anemones, which tend to prefer the ridge or dome crests. Valley or basin bottoms are virtually bare, with an extremely low diversity and abundance of epifauna. The bottom sediment is easily resuspended.

245 m Climbing slope (perhaps 1 - 2 m uphill). Gradients on slope about 15 degrees. Lots of holes on the surface. Scattered shell debris. Large stringers up to 5 cm along, oriented near horizontal in the water column. The crests or peaks of the domes on the sea floor are not oriented and appear to have an almost random distribution. Large basket star. Scattered Swiss-cheese holes (~ 10 cm across). The abundance of the holes is steadily increasing to about 1 - 2 per square meter. Scattered brittle stars and stubby white anemones.

247 m - angular boulder covered with epilithic fauna. Small silt-covered cobbles. Isolated Buccinid gastropods, brittle stars, star fish and egg sacks. Anemones have a density of 1 - 2 per sq. meter. Small isolated fish. Ten degree slopes -- no anemones on slope or on bottom; only occuring on the peaks of the domes. Some small angular boulders. Octupus; abundant fist-size "Swiss-cheese" holes, many of which are infilling with sediment. Domes tend to be bare on the slopes, which have isolated holes. As one reaches the crest of the dome, the number of anemones increases. Isolated star fish. Quite marked rolling topography on the sea floor. Isolated small cobble.

242 m Silt covered area; sea urchin. Visibility poor. Lots of anemones on rise of hills. Very small anemones; small fish; scattered holes. Isolated cobbles covered in silt. Up to 10 - 15 degrees on the slopes of the domes. Swiss cheese holes ~ 2 - 3 / m^2

Very steep (30+ degrees) slope. Mainly bare with a few isolated anemones and brittle stars. One hole about 1/3 m across lined with smaller holes. Isolated fish; few brittle stars and small gastropods. Larger Swiss cheese holes are now 10 cm across; Sea floor pitted with holes. Large hole about the size of a large basketball, filled in with sediment. Isolated rounded cobbles.

237 m - big 3 m climb - more defined crestline to the ridge, more 2-dimensional in form compared with the more 3-D hummocks at the base of slope. Oriented perpendicular to the path of the *Pisces* (which is upfjord).

283 m Course 280. Rolling bottom. Isolated retractable white polychaetes and Swiss cheese holes. Scattered brittle strtars 2 - 3 / m^2 . Small finger size holes . Isolated fish and cobble.

282 m up 1 metre. Anemones more abundant on crest; isolated Swiss cheese hole. Sea urchins, egg sacks or a different type of anemone. 0.5 m diameter basket star. Visibility worse.

On top of crest: shell debris littered about. Isolated anemones 2 - 3 / m^2 . *Macoma* shells and other bivalves. Cobble about 0.5 m long. Anemone density increasing to 3 - 4 / m^2 . Isolated Swiss-cheese holes. Isolated cobble and *Macoma* hash. Brittle star density decreased. Basket star. Finger-size holes due to agglutinated polychaete holes. Group of gastropods (5 or 6 Buccinid). Large hydrozoan (? albino sea pen) tubes 30-35 cm long x 2-3 cm wide with a central reddish stalk -- the tube is transparent with a slight bluish tinge ; fairly common 3 - 4 / m^2 . Isolated Alcyonacean. Shell hash on sea floor.

236 m. Holding pretty flat. Has been level for awhile. Very gentle gradient come up ~ 10 m. More shelly material on sea floor.

233.5 m spiney sea urchin. Scattered round boulder; polychaete tubes have fecal mounds, perhaps marine isopods (? *Cirolana*), ~ 2 cm long swiss cheese holes and mounds.

234 m turn to port; course change to 180. Star fish and abundant Swiss cheese holes; anemone fairly common; isolated shell detritus; marine isopods (? *Cirolana*) common , i.e. littering the sea floor.

232 m - spiney sea urchin. Increase in albino sea pens; sun star; number of Swiss cheese holes has increased. Scattered Macoma shells and gastropods. A lot more tiny brittle stars 2 - 3 cm across. Red star fish. Tiny sabellid polychaetes -- stick out about 4 - 5 cm like grass from the sediment, average about 4/ m^2 . Large silt covered boulder.

230 m - Octopus. Brittle stars giganticus. 4 or 5 holes in a row -- rectangular about 0.3 m across -- Narwhal munch marks ?? First shrimp. A dozen lined-up holes, rectangular . One appears to have collapsed (whale holes). Number of retractable white polychaetes increasing to 6 / m^2 ; isolated brittle star; small polychaetes ~ 10 / m^2. Lots of tiny brittle stars ~ 1 cm across in densities of 30 - 40 / m^2. Many large brittle stars are hard to see because they are buried in the silt.

218 m Up a slight gradient; a bit of an up-and-down topography. In contrast to the flat bottom areas there are a lot more anemones and brittle stars are smaller. Few places rippled or wavy sediment. Large

cavity 0.4 m across ? compaction (?whale mark which has then collapsed or else collapse around buried boulders). Polychaete tubes in densitites of 5 - 10 / m^2; sun star; small gastropods 1 - 3 cm long tannish white in coloration.

209 m -- sea urchins become common. Some dead sea urchin shells, couple of pink anemones and a sun star. Large angular boulder 1+ m across covered with silt, only fauna are sea urchins and a brittle star having a picnic on the top. Isolated buried angular boulders. Rocks covered with silt and sea urchins. Many moribund sea urchins. Small brittle stars (1 - 2 cm across), with densities of 10 - 20 / m^2 . Sediment is very easily resuspended on the bottom.

191 m - coming up an angle of repose (30 degree) slope. Angular boulders (1/2 - 1 m across). Armies of small brittle stars (1 - 2 cm across); polychaete density: 10 - 20 /m^2. Isolated retractable white polychaetes. Red starfish. Larger angular boulder 0.6 m across fresh -- absolutely bare. Sediment easilty resuspended. Shell debris -- bivalve sampled with arm.

175 m - Kelp detritus, sea urchins; great variety of brittle stars (various sizes, shapes and colors) ; many angular boulders mud covered , up to 0.5 m across. Hit bedrock. Silt covered outcrop; brittle stars, isolated swiss cheese holes; encrusting sponges, some anemones, brittle stars have a patchy distribution; serpulid worm tubes and small round sponges (white).

Bedrock ledges have < 1 mm to 1 cm silt covering. Boulders have attached sponges. Dead and live sea urchins, number of brittle stars decreases. Large encrusting white sponge (patches up to 0.5 m across); attached orange anemone; abundant serpulid worm tubes.

103 m _ castle-like sponges (resemble fire coral in Florida); crinoid 40 cm across; small ball sponges -- all of these epilithics are on the down-gradient lee of small bedrock overhangs. Serpulid worms and encrusting white and yellow sponges are the dominant epilithics. Abundant clam shell; scattered cobbles. Very little current velocity.

Large boulders. Retractable white polychaetes are becoming more abundant. Spiney sea urchins. Small brittle stars (1 cm across - 2 cm) are in density of 5 - 10/ m^2; kelp detritus.

81 m - encrusting sponge 1/2 - 1 m across (yellow); serpulid worm tubes coat the outcrop. Calcareous encrusting bryozoans. Spherical sponges. Crinoids.

75 m - More silty coating on the bedrock; smaller spherical sponges; pink anemone, 30 cm across, Small brittle stars; many Swiss cheese holes. White, stubby short anemones are more common on the silty slope. Egg sacks

68 m - Scattered bivalve shells and small polychaetes; brittle stars in density of 20 /m ^{2}. Small button jellyfish (about 2 cm across, button shaped, with an orange center and yellow rim; with clear tentacles).

63 m - shell hash; Swiss cheese holes are bigger 10 - 20 cm across. Kelp detritus; encrusting white sponge; orange to reddish colored sea urchins; bryozoans; sperical white sponges.

50 m Overhang on bedrock. Serpulid worm tubes; encrusting sponge. Silt covered slope with spherical sponges (white).

40 m - red sponge encrusting; other form is white and resembles fire coral (castle sponge); small brittle stars (2 cm acrss) in densities of 20 /m^2 . Red algae on rocks. Shell debris. Silt coating on slope.

35 m - abundant sponge; encrusting red; small brittle stars; shell hash; brown algae; polychaetes; red algae common. Lots of ambient light.

25 m - abundant seaweed; scattered brittle stars; shell hash; algae coating. Bottom sediment easily resuspended. Brown algae coating on seafloor. Abundant shell hash (like an intertidal zone) Large (2 - 3 m) boulders; large crinoids 40 cm diameter.

20 m Boulder field. Abundant shell debris and silty mud coating and brown algae. Abundant shell debris.

16 m - kelp lot more common, covers everything. Isolated cobbles. 2 - 3 m long boulders and smaller scattered boulders. Shell debris. Lot of zooplankton.

LAND PARTY ASHORE AT HEAD OF MAKTAK FIORD
SYVITSKI, HODGE & HEIN PARTY
SEPT. 9, 1985 18:00 - 20:00

We landed south side of the fan-delta at the head of Maktak fiord. A large reworked side-entry moraine extended along the south side of the fjord, and was cut by a side-entry stream. The stream traversed a bedrock high (forming fantastic waterfalls) emerging out on to the base of slope as a

small fan-delta. The feeder stream was floored with large boulders and cobbles . Either side of the stream was flanked by aeolian sediment, which was frozen 0.5 m below the surface . Cross-sections through the aeolian sediment piles showed small-scale faults, very high (>35 degree) cross-bedding and deformed laminations. In periglacial environments were permafrost is prevalent a unique set of aeolian products are produced. For example as the lee of the dune complex progrades it does so over 50 degree slopes. Or, during the erosion by the side-entry stream, the most important concept is thermal erosion of the permafrost: a consequence are ice tunnels through the frozen sediment. We climbed up the aeolian sand ridge and made our way to the head stream. The sand was fine-to medium grained, and, as expected, very well sorted. All along the flanks of the ridge were high (> 35 degree) slopes covered with aeolian straight-crested ripples, 1 - 2 cm high with a crest-to-crest spacing of about 5 - 6 cm. Crest lines were parallel. No sediment was in transport. Even upon disturbance by our walking it only sloughed down the ridge.

Upon emerging at the top of the sand ridge, we encountered a boulder strewn hill slope, which down at the base-of-slope area becomes infilled with small patches of aeolian sand (sand shadows) many of which have small straight-crested aeolian ripples on the surface -- 1 cm high x 2 - 3 cm spacing.

Going downslope onto the main part of the sand ridge, the height and spacing of the aeolian bedforms increased markedly. About 3/4 of the way down-slope, the bedforms are of two scales. The larger coarser-grained bedform (medium to coarse sand) is molded into isolated, sinuous crested dunes, which are 2 -3 cm high with crestlines traceable along strike for 0.3 - 0.5 meters. In the area between the larger sinuous-crested dunes, are small continuous sand ribbons, which streak along the sand sea, running parallel to the base-of-slope of the valley (i.e. with crestlines parallel to the predominant wind direction). Near the margin of the sand ridge, there is a more water saturated zone, medium brown in color, which upon loading becomes easily liquefied. Mud is contributed to the dune through drainage off the mountain slopes. Ocassionally where the flow is large, a sinuous, possibly meandering, channel is cut into the dune. In one example a sinuous channel was filled with fresh aeolian sediment that was highly unconsolidated.

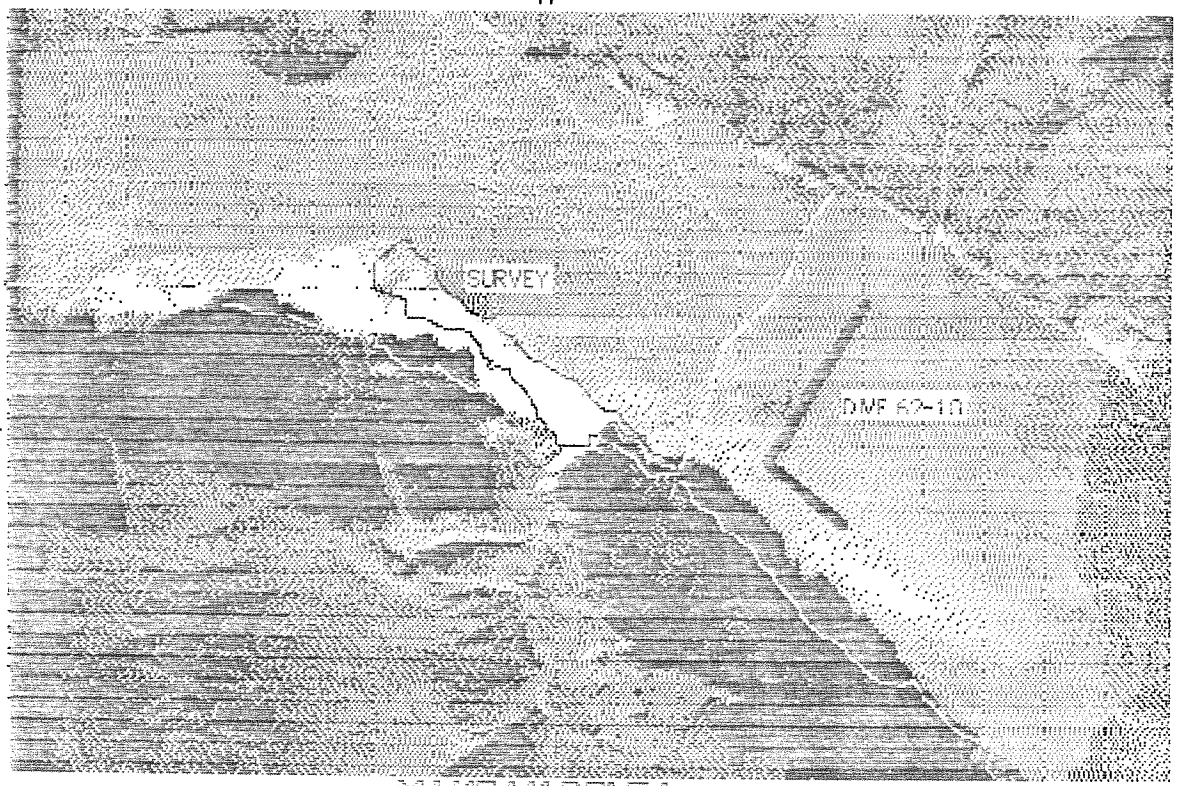
We walked upvalley to the next sand ridge complex. As with the first sand ridge, this complex occurs in the lee of an area of large boulders along the valley-wall. In profile, the sand ridges appear to have a similar shape to that of a more typical alluvial fan -- however, these are obviously aeolian

--formed with some reworking by side entry streams and runoff, which perhaps lessens the gradient of the profile of the original aeolian ridge. At two or three sites, we crossed side-entry streams. These cut across the sand ridges and flowed under the sand (almost upon entry) to the base-of-slope along the valley wall. Steep-sided banks are cut into the sand ridge at the entry point. A few meters down-slope, the stream develops a small fan, comprised of overlapping sandy lobes, which build up a pile of sand (0.5 m high and across the width of the side stream (1 - 2 m)). About 10 meters upstream of the overlapping sandy-lobe fans, the present water flow sinks into the sand and travels under the sand ridge, until it emerges with the sandy braid plain of the main fluvial valley. Sediment is very easily liquefied, and our feet sank in about 20- 30 cm. Some reaches of these channels cut in the sand ridge are steep-banked, floored with mini-braided and overlapping sandy lobes, whereas other reaches are almost completely infilled with aeolian sand. The reason for this may be that many of the steep-bank reaches are filled in with snow during the winter, whereas the sand-filled reaches are snow-free during the winter, receiving aeolian infill during winter sand storms.

The main braidplain of the valley is completely sandy. There is apparently very little variation in the system. It all appears to be sandy and a multichannel, complicated sandur system. The only vegetation in the valley proper are small clumps of arctic grass, which tended to stabilize the sand at the toe of the upstream sand ridge.

The wave influence at the head of the sandy delta is minimal -- small ridges run parallel to the front of the sandy delta; probably built during high wave activity associated with storms. Two of these ridges were emergent at the south end of the sandy delta. Perhaps a third occurred just offshore of the delta top. Again the delta shows very little variation in sediment size or channel shape -- it mainly consists of a complex braided channel pattern.

Walking back across the coarse-grained fan-delta at the south side of the head, there was a small cutbank (0.5 m) from the sand ridge down onto the fan delta top. The fan delta is comprised of very coarse-grained cobbles, gravel and strewn boulders which are being infilled with finer sand. Some of the smaller channels have thin patches of sand moving with isolated fields of small current ripples moving amongst the coarser gravel clasts, strewn across the channel floors. There is a preferred fabric to the gravel and cobble clasts -- a-axis flow transverse, b-axis imbricate pattern. However, the fabric is not well developed.



DIVE 85-062-10: 1670 MAKTAK PRODELTA
SYVITSKI / SCHAFER / TAYLOR
SEPT. 8, 1985: 14:30 - 16:50

In general, visibility throughout the dive ranged from zero to less than 2 m. SPM consisted of fine sand size particles that were relatively even grain sized; sorting decreased with depth. However, the water between these larger particles was very milky suggesting that the flocculation process was not complete (too short a residence time). Flocs were noted in the upper part of the water column. Stringers began to appear in the lower part of the water column (50 - 70 m) where they were generally short (1 - 2 cm) joining, or with attached, floc grains. Some stingers were as large as 5 cm. Zooplankton consisted mostly of copepods and euphausiids. Other species were either absent or in minor abundances (e.g. *oikopleura*). We traversed under the Maktak plume a couple of time: visisbility decreased rapidly and the pilot could no longer see the bottom.

The purpose of the dive was to investigated the nature of channels (turbidity current origin?) on the Maktak prodelta. Channels were encountered three times: at 70, 45 and 76 m. Channel walls were up to one m high and gave way to complex "stepped" walls (walls made up of several en-echelon small walls and benches) in a down channel direction. On average the height of individual steps was between 20-30 cm. Some channels were draped by muddy

sediment indicating that they were no longer active. Others showed evidence of undercutting in the form of sediment "blocks" lying at the base of vertical channel walls. Thus at the base of these channels an interclast breccia is presently forming (with medium to high preservation potential). One of the seemingly freshly cut channels was about 3 m deep. Individual gravity flow deposits (sand) outlined in cross-section on cut channel walls varied in thickness by about a factor of three. Wall faces were distinctly cuspate in shape (mean radius of perhaps 0.5-2 m). The channel floors were lined with straight crested asymmetric current ripples with flow indications down the channel. However, no channel was so recent to not have a 1 cm covering of suspension silt draped over the ripples. Based on observations of the rate of particle settling velocity and concentration of SPM, we estimate that a few mm of sediment would cover the seafloor within a tidal cycle.

Interchannel areas were composed of relatively fine sediment and were populated at some localities by comparatively dense populations of polycheates relative to channel floors. The polychaetes protruded the seafloor by 3 to 10 cm and their patchy density ranged from 20 to 300 m^2. The greater area of interchannel sediment is also populated by brittle stars (3 species with *robusta* dominating), occasional gastropods (unornamented), sea anemones (pink) and retractable white polychaetes, and crinoids that are living under high ambient turbidity conditions. The crinoids were relatively common between 70 m and 40 m: they reached heights of 35 to 40 cm. Some evidence of bivalve and burrowing worms were seen with rare mud volcanoes and fecal mounds.

The infauna in the channnels was dependent on the thickness of the recent softer suspension fallout (and therefore the time seperation of gravity flows) and the rate of benthic establishment. Infauna are highly limited because of the dense packing of the underlying sand. Ophiurids are the first to venture onto the channel floors.

DIVE 85-065-11: 1671 Upper Maktak Fiord
HODGE / GILBERT / TAYLOR
Sept. 9, 1985: 09:10 - 11:15

The purpose of this dive was to describe micro-features associated with some very large scale soft sediment folding (identified from 1982 high resolution Huntec reflection seismic records). Great quantities of *Oikopleura* were observed through the first 50 m of descent - it was presumed that they may be reacting to the bright day outside, rising in the

water column to the light. There was a surprisingly heavy load of SPM in the water column, considering the dive site was 4-5 miles from the head of the fjord. Stringers and flocs occur in increasing numbers and size with depth. We struck the bottom at 161 m; it appeared to be a soft, very fine grained, muddy material showing slight bioturbation with small, finger-holes, tracks from gastropods, etc. Visibility was approximately 2 m, with SPM settling continuously. There appeared to be no current.

Common life forms are 2 or 3 varieties of brittle stars (grey, pink, and hairy), krill and ghost shrimp, retractable white polychaetes, crinoids, some rose anenomes, and the everpresent eelpouts. Occasionally gastropods were seen hosting anenomes. Urchins were also found, and some sea spiders *(Pycnogonid collosendea)* were identified.

A new apparatus for dropping balls onto the seafloor from the Pisces overhead arm had been installed for this dive. 3 separate "drops" were tried, and a core was taken alongside each attempt. The coring appears very rough, the material collected may be reduced to a sample rather than a useable core. Observations of the balls contacting and settling into the sediments were made and recorded both on video as well as with still cameras.

Along the course of the dive, occasional dropstones were found, generally sitting in a crater roughly 1/4 to 1/2 their own depth. The 'stones' varied in size from large cobbles to 1 cu. m. Other than the dropstones, the bottom remained very nearly flat throughout the flight path along the axis of the fjord. The density and variation of life also remained constant.

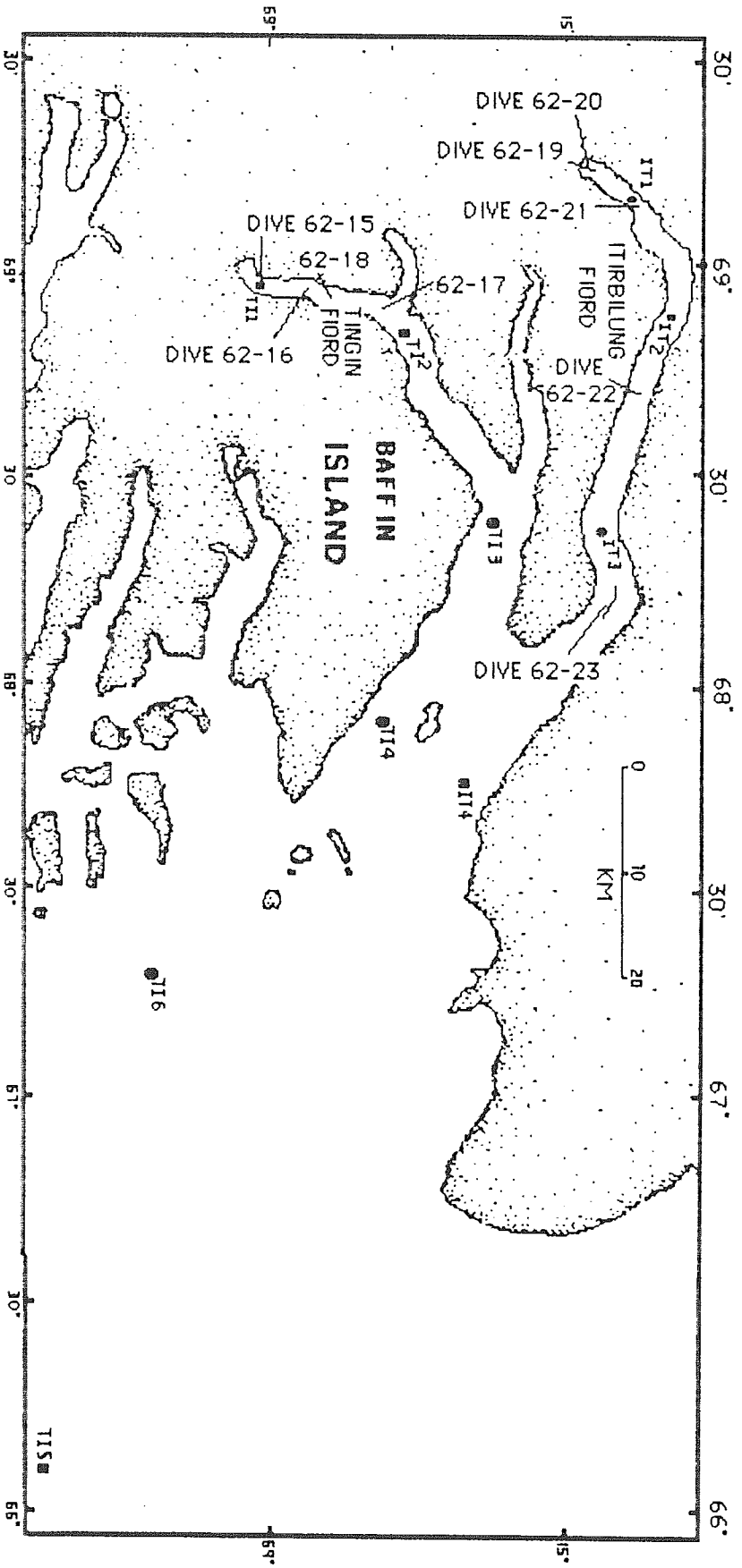
After approximately 1 hour, we turned for the wall; the depth had shallowed to 150 m, the bottom characteristics had not changed significantly. At 144 m we started climbing a very slight slope, the incline was steady (about a 1 m rise in 30-50 m travelled) although we did appear to go through a few shallow undulations. SPM continued to fall out heavily, visibility remained about 2 m, the bottom characteristics and the density and distribution of fauna had not significantly changed.

The climb to the side of the fjord was gradual and constant, steepening slightly. SPM was heavy and increasing as we rose, and flocs and stringers became scarse to non-existant, while visibility decreased accordingly. The bottom remained the same throughout the climb: slightly bioturbated, worm holes, crinoids, brittle stars, very occasionally a starfish or an urchin -- characteristics much the same as previous in the dive. At about 40 m. some "dents" or "gouges" were seen, but no apparent reason for their cause or origin was determined.

We broke off from the climb at 26m, just as the bottom was becoming more interesting. Ambient light was available and greater numbers of worm tubes, starfish and other life began to appear. Rates of sedimentation remained high as we rotated the vehicle through180 degrees and flew off into a galaxy of SPM and *Oikopleura* to end our journey. After being retrieved by the Pandora, a quick glance to shore indicated that we had most likely been climbing up a delta fan of a side entry drainage system, which would help explain a) the high and constant sedimentation rate, and b) the shallow and constant slope endured throughout the ascent.

Other specifics are given below.
Shortly after arriving the first ball experiment was carried out. Ball in about one quarter way, small crater with raised lip about 5 mm. Core NO. 1 recovered here. Proceeded upfjord on course 290 degreees. Stopped at 158 metres to recover a gastropod and sea anemone. Returned to the surface where they were preserved in 10% buffered formalin. Time 9:53, second ball drop experiment at this site: results as above. Mud cloud drifts slowly to port (south) across the fiord at several cm/s. Second core recovered. Stopped at end of upfjord run at 150 m and dropped third ball. Ball sank in less than previous ones. Crater had a slightly rasied rim around ball. Mud cloud drifted off slowly to port (south). Fourth ball experiment on upwall portion of dive. 70 mm and 35 mm photos at time of impact. Sediment response as before. Depth 144 m. Moved upslope a few undulations about 5 m long and 1 m deep about 140 metres. Bottom essentially unchanged (soft sediment, similar fauna). Siphon tube holes increasingly common above 120 m. Changed tapes at 90 m depth.

TINGIN FIORD



DIVE 85-062-17: 1672 TINGIN LOWER SLIDE (MID FJORD)
GILBERT/HODGE/WITCOMBE
SEPT. 10,1985: 09:48 - 13:00

The purpose of this dive was to collect information on the distal portion of a large slide/channel complex that dominates the bottom morphology of Tingin Fiord. Dive began at 0945. From 0 to 50m there occurred large concentrations of *Oikopleura*, perhaps related to the intensity of sunlight on the surface. Below 50m the concentration decreased and other zooplankton became more evident. Inorganic sediment concentration was low and visibility was about 4 metres. The bottom at 340 metres was sandy mud, somewhat bioturbated. The terrain was nearly flat. Large brittle stars were common, along with small gastropods, "feather worms" and some Asteroidea (common stars, cushion stars etc). Large basket stars occured about every 50 metres. A few dropstones were seen at the beginning of the run, with numbers increasing slightly along the run, and especially after turning toward the wall.

The first 70 mm photo was taken shortly after reaching bottom. Course was upfjord 195 degrees. We proceeded up a gentle incline along a nearly featureless bottom. The second 70mm photo was at 16 min 30 seconds along course. Depth about 315m. The third 70mm photo was where we stopped for the first core station. The first drop ball experiment occurred at the core site, 20 to 25 mintues along course. The corer pushed in twice to get about 15cm core. Depth 316 metres. The fifth 70mm photo was taken 29 minutes along course.

We stopped at 45 to 55 minutes for a second ball and core at a depth of 310 metres. Ball penetrated about 1/8 way in. A slight crater formed around the base. The core penetrated fully into the sediment; recovery was about 2/3 full. We started up the wall at 55 minutes. The bottom was flat then rising more steeply from about 310m. A number of gentle undulations were encountered above this depth, their height ranged from 1 to 2m, and length 10 to 20m. More drop stones were evident and as the wall steepened, larger boulders became more common. A third core was taken in sandy sediment about 230m depth. About 1/3 of the barrel penetrated. The dive ended about 200 metres while the bottom was still muddy with drop stones.

DIVE 85-062-18: 1673 MIDDLE OF SLIDE (TINGIN)
HEIN/SYVITSKI/WITCOMBE
SEPT.10, 1985; 14:32 - 16:40

The purpose of this dive was to describe features associated with the large slide/channel complex described in the previous dive. In particular we wished to observe potential cut-banks and stratigraphically desribe the section. At 19 m - very large *Oikopleura*, some large stringers with attached SPM (stringers 5 - 7 cm long). *Oikopleura* density is 5 - 10/m^2; sea gooseberries. By 20m - more SPM between *Oikiopleura*, density of *Oikiopleura* increased to 10 - 15/m^2; 5 - 7 m visibility. By 30m - *Oikoplura* density decreased. Blue dart fish (few cm long, dart around in an angular propelling motion; some blue or green coloration). By 35 m - density of *Oikopleura* cut by 25%; copepods more abundant, few stringers visible.

269 m - On bottom. Visibility 7m; light compacted sand. Few krill. Some Buccinid gastropods; scattered Alcyonacean; large red starfish, various size brittle stars, basket star. Sea spiders ? 3 - 4 cm long pycnogonid Collosendea; small polychaetes. Sculpin fish; fecal mounds 2 - 3 cm across; some boulders encrusted with bryozoans and silted over. Isolated Swiss cheese holes. Feathery fat polychaete. Large brittle stars (giganticus); eel pout fish in vegetation on boulder. Density of marine isopods Cirolana are 20-30/m^2; another sea spider pycnogonoid; *Collosendea*, red shrimps; small 2 - 3 cm long tannish gastropod; small basket star (20 - 30 cm across) on boulder. The boulder is scoured on one side. Some sabellid polychaete tubes sticking out a cm or two.

Large anemones were found on a large boulder that was scoured on the north side. Isolated Alycoacean. Sea urchin. Small 2 - 3 cm long gastropods; basket stars. Isolated cobbles ~ 40 cm across; silt covered. Fairly featureless boring bottom; Isolated boulders covered with epilithic fauna, scoured to the north side. Retractable white polychaetes in densities of 3 - 4 / m^2; Boulder scoured heavily on port side of our track. The basket stars seem to be a predator of the hydrozoans. Angular pebbles, cobbles and boulders. Sea spider pycnogonid Collosendea; few middle size brittle stars in densities of 4 - 5 / m^2. Angular cobble (? 10 cm long) fresh, although silt covered. Most of the boulders have basket stars and coon shrimp. Basket star was found eating a hydrozoan.

266 m - isolated Alcyonacean, red star fish, scattered medium size brittle stars. Large boulder scoured on north side. Anemones in densities of 1/3-m^2; hydrozoans <1/3- m^2; sea urchins rare, some buried brittle stars.

265 m - large basket star (0.5 m across); isolated boulders, silt covered but no fauna; gastropods 1 - 2 cm long; rare sea spiders pycnogonid. Collosendea; starfish 1-2/m^2. Huge (? drop) boulder (meters across): holes all over it -- like the surface sediment caved in; now silt covered. Alcyonaceans are fairly common, as are the retractable white polychaetes. Isolated small depressions

Isolated collapse holes 4 - 5 cm across, filled in with silt. Many brittle stars (small and medium size); Another rock with a large scour hole. Scattered large pebbles and cobbles, many with scours.

161 m-irregular surface; many holes silted over medium size brittle stars in densities of 5 - 6/m^2; A large density of "Button jellyfish" (about 2 cm in diameter, clear center with orange coloration around the circumference, yellow coloration on the tentacles). Isolated angular silt-covered cobbles and boulders. Scattered rose anemone and a few sea spiders pycnogonid *Collosendea*. Regular oscillation ripples (2 - 3 cm high/few cm spacing) trending downslope with the crestlines perpendicular to the gradient. A few 3-dimensional linguoid current ripples, with about the same dimensions as the oscillation ripples. Swiss cheese holes common; large angular silt-covered boulders, scoured on the down-current side. Isolated smaller cobbles; Very irregular microtopography -- many holes were nearly infilled with sediment.

142 m -- retractable white polychaetes in densities of 4 - 5/m^2; small brittle starfish in densities of 10 - 20/m^2; sea urchins scattered. Isolated fresh angular cobbles and boulders, fresh surfaces with no silty mud covering.

134 m - pretty gentle wall slope. Life on the wall is not that different from the base-of-slope; although the numbers (i.e. density of fauna) has decreased. Some starfish, smaller white anemones. Many large angular boulders on the sea floor, covered in silty mud. Retractable white polychaetes in densities of 1 - 4/two; m^2; a few small brittle stars. One collapse hole (20 cm diameter), filled in with finer sediment. Scattered silt-covered angular boulders and cobbles. On down-gradient side of boulders are encrusting bryozoans and other attached fauna. Cushion star. Abundant polychaete holes about 1cm in diameter.

113 m -- small retractable white polychaetes in densities of 5 - 6/m^2; otherwise few fauna; some isolated medium size brittle stars. Scattered boulders and cobbles -- some are are others are silt-covered; rose colored anemones (10-156 cm across); branching *Alcyonacean*

101m -- Scattered large boulders, some buried in sediment, others covered with 2 - 3 cm sediment still other boulders bare. Brittle stars in densities of 4 - 8/m^2; retractable white polychaetes in densities of 2/m^2; rose colored anemones (10 - 15 cm diameter); crinoids; dead sea urchin tests.

90 m -- Some big irregular holes. Boulder density is increasing -- some are completely buried in sediment. Some of the boulders have attached and epilithic fauna, including encrusting white sponge. Kelp detritus. Stable slope. Few mud volcanoes. Branching *Alcyonacean*, scattered sea urchins. Some bare angular fresh boulders. Red Aster starfish.

70 m -- kelp detritus; # of spiny sea urchins increasing; isolated silt-covered boulders, shell debris, including *Macoma* and dead sea urchins. Scattered boulders and cobbles, some nearly buried; some attached and epilithic fauna on the down-gradient side of the boulders.

?55m -- Brown algae. Scattered boulders with attached crinoids; density of sea urchins increases a lot (? 4 - 5/m^2;) A slump surface with many large cobbles and mixed-up disturbed sediment -- covers most of the port hole view.

53 m -- red algae first occurrence. Brown algae coating all over everything. Sea urchins; polychaete holes (1 cm diameter); some medium-size brittle stars. *Oikopleura* density is increasing; Red Aster starfish are very common. The anemones are absent. Most of the boulders are covered in red algae. Very rare hydrozoans. Number of brittle stars decreasing. Shell hash -- abundant bivalves. Boulders coated in red algae.

33 m -- Kelp first appears. Abundant small brittle stars (2 - 3 cm across); shell hash litters the sea floor. We are in a large boulder field (very angular boulders, 2 - 3 m long) which is sitting on a surprisingly gentle slope. The boulders are quite fresh, not covered in silt. Few red Aster starfish. Cobbles also occur in the field, but are not as fresh as the boulders and are partly silt-covered. Some small swimming bivalves, look like tiny scallops.

Except for the resedimented boulder slide, features that may relate to the slide/channel were noticeably absent on this dive.

DIVE 85-062-15; 1674 TINGIN FIORD-HEAD DIVE (SLIDE CROWN)
SYVITSKI/HEIN/WITCOMBE
SEPT. 11; 1985: 09:00 - 11:20

Maximum depth 119 m. These dive operations at head of the fjord were to locate and describe the crown of thesubmarine channel.

110m -- on bottom. Visibility ~4m. Hard compact sand. Scattered medium size brittle stars; isolated polychaete holes (1cm diameter); small fish resembling smelt; some bearded brittle stars. SPM particles not settling very fast. Small gastropods 1 - 2 cm long, white to tannish in coloration. Microrelief on the bottom is subdued and appears to be silted over biologic holes and craters. Few scattered medium size (body ~1/2 cm long) brittle stars; some of which are buried -- densities of ~4/m2. Isolated retractable white polychaetes. Pteropod floating by. Isolated attached white sponge (castle-type tubes); few larger white starfish; very low density of fauna; few brittle stars and one or two anemones/m^2. Large red Aster starfish. Isolated rectangular hole -- either a Narwhal munch mark or a very unusual scour feature. Also some 30cm long x 10cm wide angular cuts on the seafloor. Some fecal mounds (10 - 30 cm in diameter). Polychaete holes (~1 cm diameter) are very common. Abundant krill. Again the subdued microrelief on the bottom is due to infill of bioturbation structures.

110m; time 09:31 ADT few isolated medium-size brittle stars; isolated retractable white polychaetes. Some Swiss-cheese holes. Some gradual undulation a few cm - 10 cm high on the sea floor. 5 or 6 holes angular in a row on the seafloor -- marks every few meters: 30 - 40 cm long x 5 - 10 cm wide. All lined up straight. 3 or 4 large red Aster starfish. Few branching anemone Alcyonacean. Brittle stars and retractable white polychaetes are ? 2 - 3 cm high, densities of 1 - 2/m^2; brittle star density is a few/m^2; Very gentle (cm high) undulating microrelief on the seafloor.

Very large basket stars; isolated retractable white polychaetes in densities of 3/m^2; isolated mounds (? fecal); few branching *Alcyonacean* -- densities of 3 - 4/m^2; red Aster starfish in groups of 2 or 3; retractable white polychaetes are now down to 1 - 2/m^2; brittle star density of 3-4/m^2; very gentle bottom gradient. Skidoo-shaped tracks with lined up holes.

Course 204^0; 107m -- very gentle slope; gradual dropoff to starboard; sea life hasn't really changed. We are coming down about a 5 m drop.

Back on track; 107 m on course; coming down a 10 m drop -- few mounds, few red Aster starfish; very few fauna -- barren; few buried brittle stars; isolated retractable white polychaetes.

120m -- mounds -- about 10-20 cm across, but don't appear to be fecal mounds; many 1 cm diameter polychaete holes; retractable white polychaetes in densities of 2 - 3/m^2; medium size brittle stars and a few large brittle stars; small scrape marks on the seafloor; large fecal mounds -- largest in all of our dives (? 20 cm across x 10 cm high)

118m -- 3 or 4 Swiss cheese holes, red Aster Starfish; branching anemone Alcyonacean. Mounds of fecal material (5cm across), medium size brittle stars in densities of 3 - 4/m^2; scattered retractable white polychaetes, in densities of 3 - 4/m^2. Perhaps approaching crestline of a dome -- not a sharp curve; many Swiss cheese holes; scattered small and medium size brittle stars. More holes square at one end, rounded at the other, long linear holes (? whale markings).

119 m -- going into a depression and back above. Swiss-cheese holes, anemones more common, as coming upslope get an increase in density of anemones and they become larger in size. Some kelp detritus. Narwhale holes again. Small brittle stars in densities of 3 - 4/m^2; scattered red Aster starfish and branching anemones Alcyonaceans. All of the brittle stars are tiny(1-2 cm across). Very gradual slope, then go up a 12-15 degree gradient; few silt-covered boulders.

113m -- Pteropods 3/m^3; Gigantic brittle star (?15-20 cm across); abundant 1 cm diameter polychaete holes. Gradient appears to be increasing (? 15 degrees now). Mounds about 50 - 75 cm across -- ? covered boulders or else small plastic-deformed dislocations or folded sediment. Very low diversity and numbers of fauna. Medium-size brittle stars; one sea cucumber Holothurian; few retractable white polychaetes.

111m -- Large mounds (? 0.5m high). Very low diversity and number of fauna. Isolated branching *Alcyonacean*; isolated to scattered polychaete worm holes. Small depressions 10's metres long x 0.5 - 1 m high (? small gulleys or dislocation slippage surfaces) the orientations of these depressions in down-the slope gradient. 30 cm-wide hole - perhaps a collapse crater. Some *Oikopleura* Narwhal scrape marks; isolated silt-covered pebbles and cobbles. Marine isopods *Cirolana* (~2 cm long) on seafloor; Worm tubes (cm high) are becoming common.

103 m -- size and number of retractable white polychaetes increasing up to 12cm long in densities of 4-5/m^2; med-large size brittle stars common; few *Alcyonacean*, red Astar starfish scattered. Density of retractable white polychaetes decrease to 1-2/every two m^2; Very smooth bottom.

102m -- visibility drops off considerably. Climbing along a slope -- sloping off to starboard. Large basket star (40 cm across); little pink balls (a few cm across, possibly egg baskets or closed anemones); small and medium size brittle stars in densities of 1 - 3/m^2; retractable white polychaetes in densities of 2-3/m^2; *Oikopleura* increasing.

100m -- polychaete (cm size) holes still present; cobbles with attached brittle stars and basket stars; sea urchins; few white starfish. Isolated large brittle star. Local little high mounds (decimeter high) with attached anemones, isolated branching anemones Alcyonacean; few scattered small brittle stars in densities of ~2/m^2. Irregular microrelief on the seafloor -- looks like a disturbed sediment surface -- although also has a bioturbated look. One Narwhale mark; isolated red Aster starfish.

Alter course to 180. Visibility - 30%. Fauna dropping off in both numbers and diversity; scattered brittle stars, isolated large cobble and red Aster starfish. Irregular microrelief on the bottom -- again looks like an originally bioturbated surface which has become disturbed through resedimentation.

Less disturbed zone -- now looks mainly biologic.

90m - depth holding steady. Isolated small cobbles and gravel which are silt covered. Very little density of number of bottom-dwellers, although these types are generally the same as we have seen all along. Visibility has decreased to about 1 meter.

96m - very low number of fauna. Brittle stars and small retractable white polychaetes. Red Aster starfish and *Alcyonacean*. Fresh pebbles on the seafloor surface without a silt blanket. 1 - 2 m drop to starboard. Hummocky topography. Some rectangular Narwhal holes. Sea urchins becoming more noticeable. Starting to climb a more dramatic gradient. Red Aster starfish scattered. Number of Narwhale holes has decreased at 92m. Channel edge (not a cutbank) to port. Fresh big angular boulder (0.5 - 1 m long) sitting on a 20 degree slope. Swimming mobile (few cm long) polychaete worms; red Aster starfish; scattered brittle stars.Course 180; small sheet-like dislocations (0.5 to 0.75m, long, lobate), coming up to a little ledge (? 0.2m high) (? fracture). Surface

2nd LAND PARTY ASHORE AT HEAD OF TINGIN FIORD
HEIN/HODGE/SYVITSKI PARTY
Sept. 11, 1985

We landed from the zodiac midway across the northern part of the Tingin delta. We passed over a shallow (0.5m deep) stream that had a boulder-strewn sandy bottom. The main discharge from the northern river was mostly confined at the delta front to the southern-most channel. We ran an E-W line up the delta. At the western edge near the landing site, there were some sandy interchannel areas---also some topographically higher abandoned conglomerate channels and an upper level of vegetation (i.e. lichen-covered and a soil horizon) on a gravelly surface.

Raised sequences consisted of a variably exposed thickness of a very clayey (marine transgressive) mud unit that contained a few small dropstones. This unit was overlain by ≈ 3 to 5m of deltaic transgressive bottomset beds (silty mud) which in turn was overlain by up to 20m of sandy deltaic foresets. The final unit consisted of a very thin (<0.5m) topset unit of sandy gravel (fluvial) and vegetated aeolian sand (soil horizon). Some of the deltaic sequences were coarser-grained, especially the side-entry system entering near the present tide-water line to the south. There, foresets consisted of coarse gravel (upwards of 10mm in grain diameter).

DIVE 85-062-16:1675 TINGIN MEGACHANNEL DIVE
SCHAFER / ASPREY / WITCOMBE
SEPT. 11, 1985: 13:02 - 15:30

The objective of this dive was to lcoate and describe a turbidite "mega" channel that had been observed earlier on AGC side scan sonar. The dive started on the east side of the fjord (170m; 69-01.7N; 68-57.7W) at 1307 ADT and followed a course of 260 true to the west wall (70m; 69-01.3N; 68-57.0W) after which PISCES turned to 100 and traversed the fiord again to (80m; 69-01.3N; 68-56.0W) at this point it was apparent that the feature that we were looking for had no obvious surface expression and thus we began our ascent to the surface at 1529hrs ADT. We reached the surface at 1534 hrs ADT and were recovered by Pandora shortly afterwards.

The bottom sediment appeared to be a sandy silt with occasional cobble to boulder size rafted rocks. Many of the rocks were excavated around their perimeter presumably by a biological mechanism since a thin sediment veneer occurred on their flat upper surfaces. Near the west wall (90-100 m) the base of the talus slope was encountered. Very large diameter (6-8 m) boulders were observed to have a thin veneer of sediment on their upper surfaces but showed clean vertical faces encrusted with a variety of organisms.

The soft bottom sediment faces had occasional undulations (1-2m) that occurred along the entire part of the transect below 100m. One large depression with steeply sloping walls (40-50 degreees and 5-8 m high) was encountered at about 130m. This could be the feature noted as a "mega' channel on the side scan record. If so, it has been inactive for a long period of time.

The biota observed during the dive included sea urchins (<70-80m), limbate star fish, sea anemones that were especially dense and large sized on sloping sediment surfaces; some snails and juvenile fish were also observed but showed no distinctive bathymetric distribution pattern. Fresh scours approx. 5cm wide, 25cm long and 5cm deep were observed. These scours could have been made by a whale or seal. The scours were also noted during earlier dives in this fjord.

Suspended sediment size appeared to decrease with depth and the water took on a milky shade at about +100m. In general, the bottom appeared to be comparatively quiescent sedimentologically. Perhaps the flux of sediment from the delta (despite the large supply of raised marine sediment available for transport) is insufficient to scour channels at the scale of the "mega" version seen on the side scan record.

ITIRBILUNG FIORD

DIVE 85-062-19; 1676 ITITBILUNG FIORD HEAD
HEIN/ASPREY/CHAMBERS
SEPT. 12, 1985: 14:38 - 18:53

The purpose of this dive was to describe channel features that crossed the prodelta slope. First part of dive was not recorded on video. We came down onto a sharp crest upon landing. The crest stood about 2m+ above the adjacent seafloor. Along the sides of what appeared to be a cutbank were little outcrops showing parallel bedding and stratification -- sands lighter colored, overlain by darker brown or gray finer silty mud. The thickness of these stratified bands is ≈2 - 3 cm for the coarser layers, and somewhat less (? < 1-2 cm for the fines). These little cutbanks were about 0.25 to 0.5 m high and there were about 7 or 8 of them, separated by small ramps of loose debris -- as cutbank and terrace type of topography. The total relief along this terraced cutbank was perhaps 10 m. There were small fault-like dislocations running parallel to the crestlines of the cutbanks -- i.e. near-horizontal faults. The bottom sediment was very easily disturbed and very easily resuspended.

The trough axis was floored with oscillation ripple marks (few cm high x 10 cm spacing) which are continuous and straight-crested, with minor forking and bifurcations. Along the far channel side, the ripples are oscillation and also three-dimensional linguoid current ripples -- with heights of a few cm

and spacing of 10- 15 cm. Some of these ripples are oriented at an oblique angle to the main axis trend i.e. down-gradient and across-channel to the main axis. These may be due to combined flows associated with oblique sediment transport across the channel axis and up the sides as small overbank flows. These current and combined flow rippled sands may not be related to turbidity current flow -- unless they are the entrained fluid flows that are reworking the top of the channel sediment. Rather, they are probably either larger wave currents or unidirectional/combined flow currents which are reworking and flushing material down the channels.

Video started at 1730; 72 m depth ; CORE #1-- occasional brittle stars, medium-size scale. Ball drop experiment -- billiard ball didn't go in to the surface -- probably hard and compact sandy bottom, with a very thin silty covering.

Course 125°; 71.7 m; time 17:37 -- over edge of another rise oriented parallel to the down-fiord axis (≈0.5 - 1 m high), perhaps an interchannel terrace. Lots of tiny brittle stars (the smallest variety a few cm in diameter) in densities of ≈10 - 20 / m^2 ; These are the dominant fauna -- the only other evidence of life are some polychaete horizontal Planolites traces on the bottom. Rippled surface consists of silt-draped oscillation ripple marks on a very flat bottom. Ahead is a steep scarp (≈ 30 degree angle or more) which drops off suddenly. Our course is going down-fjord parallel to the main channel axis trend. Along the scarp wall are streaks which run parallel to the gradient -- i.e. longitudinal ridges about 10 cm+ in height and m's in length. They appear to be some sort of dislocation feature -- similar to the longitudinal fractures and crevasses seen on subaerial landslides. Fauna abundance is very low with a few scattered polychaete worm trails and small brittle stars.

63.5 m; time 17:45-- course perpendicular to the main fiord-axis. Going down into a trough now. At 17:49 we dropped nearly 15 meters to 78m. The bottom was silty-clay. A lot of horizontal polychaete traces ? Planolites were observed with a few scattered small brittle stars. 3-D linguoid current ripples were draped over in silty mud. Ripples are perhaps 10 cm long with spacing of about 20 cm, height ≈4-5 cm. Some symmetrical oscillation ripples 15 cm spacing, height a few cm, crestlines traceable along strike for meters. The orientation of the crestlines is perpendicular to the down-fiord axis. We appear to be in the center of a channel. Again, straight-crested ripples oriented perpendicualr to the channel axis (i.e. parallel to our track line). These oscillation ripples go on for meters and do appear to be active here -- the bottom appears to be sandy.

79 m; CORE #2 -- Polychaete traces. Ball drop experiment -- ball didn't go into sediment again. Appears to be a hard compact sandy bottom with only the thinnest veneer of silty mud. Flat part of channel floor. Polychaete worm tubes sticking a few cm out of the bottom, like sea grass.

77 m; time 18:00 --, coming up a slight gradient ? along side of channel. Symmetrical oscillation ripple marks (height few cm, spacing 10 cm or so) are on the slope, with an oblique orientation upslope and toward the main fiord axis -- at an orientation of about 10 degrees up along the flanks of the channel (i.e. away from the axis of the channel we are in). There are also some smaller oscillation to combined flow ripples , not as straight crested as the larger bedforms (described first), these smaller ripples show more forking of the crestlines. Ripple spacing is ? 3 cm, with an apparent ripple height of a couple of cm.

Course 125°: Symmetrical oscillation ripple marks: height a couple of cm; spacing 2 - 3 + cm. Sandy bottom. These ripples are straight-crested, although they do bifurcate a bit. There are also more of the combined-flow ripples mixed in with this field of ripples (i.e. little 0.5 m patches of more linguoid-looking current ripples in amongst the more regular crested oscillation ripples). Again some forking to the oscillation rippple marks; others straight crested. Obviously a complicated flow history here. Very few bottom dwellers -- few polychaete traces, and occasional small brittle star -- otherwise bare. Visibility very low -- perhaps 0.5 m.

78.5 m; time 18:10; course 125° -- very straight crested ripple marks (again a few cm high x ? 5 cm spacing), straight crestlines with very little bifurcation. A large fracture (? 5-10 cm high) extends all the way down the axis of the channel. Two other conjugate fractures (oriented at ≈ 20 degrees to the down-axis fracture) also occur. So we have a major down-axis fracture, with apparent displacement of ? 5 - 10 cm, with smaller conjugate sets oriented obliquely to the main axis trend.There are a whole series of little steps (? decimeter high) running oblique to the channel axis trend. Many fresh fracture or small fault surfaces. These steps are traceable along strike for metres. The tops of these features are covered in rippled sediment -- comprised largely of 3-D linguoid current ripples. A few smaller scale oscillation ripples occur.

80 m -- straight crested ripples with some bifurcation (? 5 cm high x 10? cm spacing, traceable along strike of crest lines for metres). Have come down into the trough a bit. ≈5 minutes later ; course 125° -- coming upon another ledge. This ledge is again perhaps 0.5 high, and is traceable along

strike of the crest for meters. The crest line is oriented obliquely to the channel axis at about 10 to 20 degrees from our track lline which is approximately perpendicular to the channel axis trend. Polychaete traces along crestline. ≈5 minutes later; course 125^0; visibility is very poor -- coming up another crest, similar to the last one. This one has active sandy 3-D linguoid current ripples along the crest. We traversed up about a 10 degree slope, symmetrical oscillation ripple marks found along the slope (i.e. crestlines are perpendicular to the channel-axis trend, parallel to our course). Sandy ripples, with straight crestlines. height afew cm; spacing between crestlines ≈10 cm.

80 m -- small ridges 0.3 m high (? compression ridges or slump scars) arcuate in plan view. Downslope from them is a sharp drop-off on the port side (downfjord) of the Pisces. Visibility poor -- the drop off seems to be perhaps a 1 - 2 + m drop off. The seafloor surface looks quite disturbed. Isolated polychaete tubes 3 - 4 cm high and a few small brittle stars (2 or 3). Sea gooseberries observed in the water column.

81 m -- going up a slight gradient. Polychaete traces, a few small white anemone (few cm high) . Appear to be 1 cm -size bivalves resembling scallops on the seafloor, which are silted over. Small brittle stars, fairly smooth slope.

82.6 m Small drop off -- seem to be climbing a series of low, broadly rolling arcuate surfaces.

83 m -- still going down. Small partially silted over bivalves resembling scallops; tiny brittle stars and small white anemones scattered about; one medium size brittle star (? robusta). Visibility a little worse (<0.5 m) possibly from an <u>active turbidity current coming from upslope.</u> The current crossed our track line -- coming from about 90 degrees upslope -- it is the wrong orientation for us to have disturbed the bottom. A whole cloud of sediment , with a turbulent front and billowing cloud ? a meter high is progressing downslope. Visibility quite poor. Going over a bed of shells, gravel or intraclasts which are covered in silty mud.

82 m; time 18:25 -- Going up a steep slope that appears to be slightly disturbed. Longitudinal marks are trending down-gradient -- about 10 cm high, and traceable for meters. Visibility almost zero. Small arcuate crest (~ 0.5 m long) perhaps a slump scar. Small longitudinal cracks (few cm high) appear fresh -- like recent fractures or tiny faults. Lots of polychaete traces, few very small brittle stars, isolated fish.

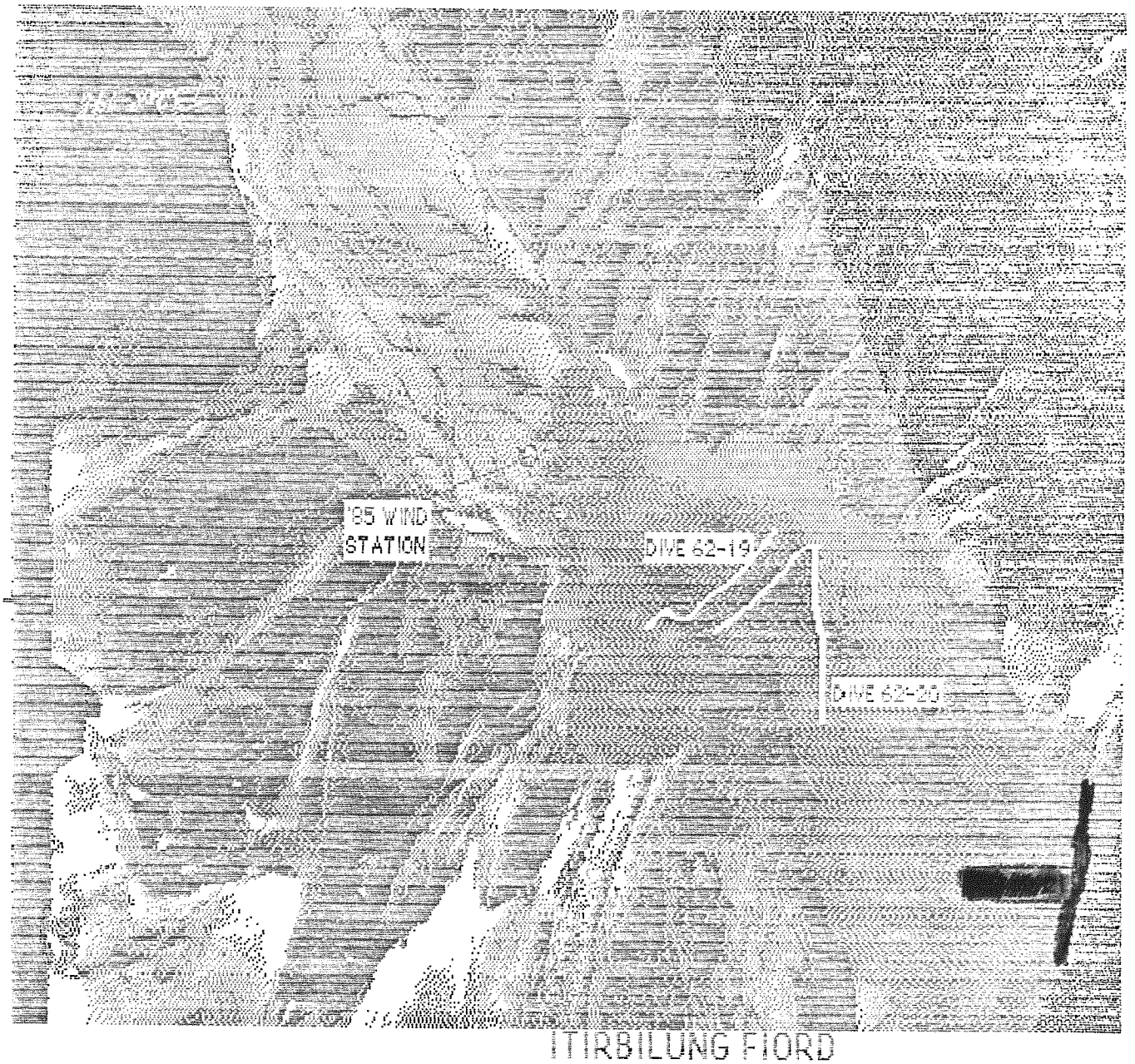
80m; time 18:28 -- very limited visibility. Larger bedform composed of irregular hummocks, rolling microtopography (0.3 - 0.4 m high x 0.5 m) wide features on the bottom. A lot more polychaete traces, small brittle stars very common, densities 10-20 / m^2 ; Go upslope -- scattered little brittle stars 5 - 10 / m^2 ; Very steep gradient (> 30 degrees); Linguoid 3-D current ripples on the port side, oriented going across the slope (i.e. contour-parallel); mudlump intraclasts or small slide deposits (0.2 x 0.3 m x 0.5 m long maximum).

77 m -- rolling hummocky surface; smaller mounds are 10 cm high x 20 cm long; decimeter size mudlump intraclasts sloughing off the port side.
Longitudinal linear cracks and ridges running parallel to the slope . At 75m, very steep mud slope with sheet-like dislocations -- decimenters in width x ? 1 metre long, lobate to sheet-like features, similar to exfoliation sheets, but peeling off the slope; small arcuate slump scars. At 76 m - slump pockets, 10 cm long, rectangular pock mark. Disturbed micro topography. At 72 m -- large polychaete traces; disturbed sloughed muddy surface. Scattered small brittle stars in densities of $\approx$ 5 / m^2 .

Change course to 180^0; 69 m -- very steep mud slope (> 30 degrees); isolated cm size holes; ? mud volcanoes; straight fractures parallel to the gradient of the slope; long linear furrows appear to be a disturbed surface; few isolated small red brittle stars. Some fractures are running parallel to the contours along the slope (up to about 1 - 2 m long). Toe of big slide. Large arcuate (concave edge pointing down gradient) slide block with attached organics. ? 0.3 - 0.4 m high x lobate feature ~ 1-2 m in dimension downslope and few metres long parallel to the contours. Just a few meters off the port side (i.e. down the main slope axis) is a ridge crest very sharp -- the lip of the toe of a slump. Linear fractures extend out to the crest of the slide, which is about 0.3 - 0.4 m above the surface of the slope x 10's of meters across along the arcuate front.

46 m -- More longitudinal furrows going downslope; 1 cm wide polychaete holes; small brittle stars scattered about; few polychaete tubes; long cracks running oblique to the downslope trend. Small dislocations on the surface; Polychaete tubes and traces are more common now. Some bivalves. Slightly undulating topography. Swiss cheese holes (5 - 10 cm across); large number of scattered cm+ size holes (? polychaetes); small depression collapse cones (few cm across) that look like impact craters. Scallop bivalves; few Swiss-cheese holes; small little depression 25 cm across (collapse hole??) Hummocky rolling microrelief, 10 cm scale in height.

37 m -- Abundant polychaetes; coming up a small high. Many bivalves, abundant brittle stars; polychaete tubes stick out a fraction from the mud surface. Surface is littered with polychaete holes. At 35 m, collapse holes are scattered around the surface ?burrows which have liquefied and failed. Abundant small brittle stars in densities of 10 -20 / m^2 ; Core #3 on slope; hummocky topography. Abundant medium size brittle stars in densities of 20-30 / m^2 ; scattered swiss-cheese holes in densities of 10 / m^2 ; small scallops and abundant small brittle stars.



DIVE 85-062-20: 1677 ITIRBILUNG FIORD PRODELTA
SCHAFER/SYVITSKI/TAYLOR
SEPT.13,1985: 09:00 - 11:30

The objective of this dive was to investigate the morphology of side scan sonar features observed on the foreslope of Itirbilung Delta between 50-100 m depth. Ambient SPM throughout the dive was moderate to high limiting visibility to 1-2 m maximum and often to less than 1 m. Observations along the deeper (≈90 m) and longest transect indicated a fine sandy silt bottom covered by numerous arcuate surface tracks (worms?), some ripple fields (1-2 cm amplitudes and 5-10 cm wavelengths), and some occasional bottom undulations of about 1-2 m in height. The fauna on this part of the foreslope is, in general, rather sparse. There are low numbers of small size sea anemones, occasional dense patches of small brittle stars and the occasional gastropod.

The walls of the turbidite channels observed along the deeper transect are cusped-shaped, perhaps because of local slumping. They have a step-like morphology in a down slope direction with a series of sloping segments intersected commonly by a layer of fine semiconsolidated and finely stratified sediment that projects through the slope face.

An experimental turbidity current that was triggered near a wall crest using the PISCES manipulator showed that tension fractures formed in the sediment above the point of excavation and failure, and that the flow travelled rapidly down the sloping wall face producing a classical clockwise eddy of sediment behind its leading edge. Evidence of channel wall slumping is inferred from the results of this experiment and from the pronounced cuspate shape of channel edges that show no evidence of recent downcutting. Rather, they look as though they were stabilized at some time in the past through post-current slumping and have failed occasionally since that time perhaps in response to sediment loading (trap results indicate upwards of 10cm/year rates of deposition).

DIVE 85-062-21:1678 ITIRBILUNG FIORD SIDE ENTRY GLACIER
GILBERT/HODGE/TAYLOR
SEPT. 13, 1985: 13:00 - 14:23

The purpose of this dive was to examine the sediment facies associated with a side-entry hanging glacier from a depth of 165 metres and along a course to side entry glacier at 280^{0}. The camera focus was not correct, and the video, especially in centre screen is blurred. The light level also appears to be somewhat low. The visibility at the bottom was about 4 to 5 m, decreasing slightly toward the surface.

The bottom was silt covered, but hard and sandy within a few cm of the surface. There was a strong current from the SW of SSW, estimated to be 0.5 m/s or more. There were a few small brittle stars, but many "feather worms" (cover up to 70% of bottom) in at least two species or forms and aggulutinated worm tubes. The bottom was relatively flat with a few drop stones. Most have erosion holes, some as deep as the stone is high so that the top of the stone is at or even below the surface. In some cases, some stones are almost covered with mud, and a few of the smaller ones are very recent drops as they have no cover, or organic growth. Some of the scours are roughly symmetrical, others are excavated more on the down-current side. In a few cases "lee dunes" nearly as high as the stones have formed down-current instead of scours. No reason could be seen for the different response (based on size, for example). A sample of a basket star from 165 m was recovered and preserved in 10% formalin in a 1 gallon bucket. Organisms in the tenticles were removed and similarily preserved.

Pisces started up a gentle, smooth slope (except for dropstones). The first crinoids were seen above 160 m (current on floor may be too strong - the first seen were closed and pushed over by the current). Worm tubes decrease above 150 m and especially above 140 m. Above about 150 m more of the large brittle stars were evident. There was very little evidence of molluscs either as shell hash or siphon tubes. Only 2 gastropod shells were seen to this point (150 m), both were empty. Sudden appearance of a few pockets of shell hash occurred about 145 m depth (especially *Hyatella arctica*). Increasing numbers of crinoids above about 150 m and by 100 m up to 1 per metre square, especially on drop stones. Asteroedea (true stars) seen in increasing numbers above 150 metres. Pectins (small translucent forms) appear about 150 m and increase in abundance to the surface where there are 10-20 per dm square. Collected a crinoid at 147 m preserved in 10% formalin. Current velocity on the slope is much decreased (several cm/s) but still SW.

By about 140 m, there is evidence that we were climbing the lateral moraine of the side-entry glacier (small stones were more abundant and the slope steepened). Shell hash increases above 115 m and siphon holes are more apparant (a few *Macoma* sp. shells on surface). Others include *Serripes* sp, *Mya truncata* and *Clinocardium* sp.. Surface stone concentrations decrease above about 110 m. Small brittle star density increases to up to 5 or more per dm square. Laminaria fragments begin about 70 m with large quantities from 60 m. Collected specimen with cushion star and other organisms and preserved in 10% formalin. The bottom is increasing sandy above 25 m. Ice scour(?) holes occur in abundance above 7 m. Dives ends at 6 m on top of lateral moraine.

DIVE 85-062-22:1679 ITIRBILUNG FIORD DEEP BASIN
SYVITSKI / SCHAFER/ WITCOMBE
SEPT.14,1985: 09:00 - 12:23

The purpose of this dive was to evaluate sediment facies on the floor and walls of a 400 m deep basin in Itirbilung Fiord. The dive started in the middle of the basin (393 m) and terminated on the south wall at a depth of about 15 m. Visibility ranged up to 15 m near the surface (<50 m) and averaged about 3-5 m near the bottom.

Bottom fauna observed on the basin floor were sparse and showed a comparatively homogeneous distribution pattern. Except for sea anemones and polycheates, there was virtually no evidence of bioturbating species. The invertebrate community included basket stars, brittle stars, snails, crinoids, and sea urchins (the latter first observed at 390 m).

Lithothamnion algae (red colored) were first evident on rock surfaces at a depth of about 44 m. Large (3-5 cm) red shrimp were noted at intermediate depths (50-200 m) and were often seen in burrows about 2-3 cm in diameter. There was an also increase in the number of burrows over the 50-200 m interval. Bottom sediments tended to be sandy throughout the dive with increased concentrations of coarse particles (pebbles and small boulders) starting on the lower slope of the south wall.

DIVE 85-062-23:1680 ITIRBILUNG FIORD SILL
HEIN/HODGE/WITCOMBE
SEPT. 14, 1985: 15:50 - 18:40

The purpose of this dive was to describe the bedrock and other sill features observed from sidescan sonar records collected in 1983. We reached the bottom at 278 m; steady current (< 1/4 knot) setting 090^{0} -- on bottom. Visibility 8 m. Large boulder-strewn bed; some are silt-covered others are fresh. Littered polychaete horizontal tubes (≈ 1 cm wide x 5 - 6 cm long; arenaceous). Many Alcyonaceans; medium-size brittle stars; small tiny white spherical sponges (? 3 cm diameter, 2 - 3 cm high) (mushroom sponges). Scattered shell debris ; concave-up shell filled with muddy silt. Sea urchins and a few crinoids. White encrusting sponge; encrusting bryozoans; large brittle and basket stars; small 1 - 2 cm long polychaetes; shell hash scattered about. All ranges in size of coarse-grained fraction from large granules to boulders several m's across; pebbly and cobbly material is also present.

Course 130^0; ≈ 5 min later -- Great diversity of fauna with abundant horizontal arenaceous worm tubes (1 cm wide x 5 - 6 cm long). Many boulders and rocks -- up to 3 - 5 m across, covered with basket stars, small coating of silt. Very low amount of suspended sediment in the water column. Crinoids sitting on boulders. Micaceous sand infilling the boulder field. Some serpulid worm tubes on the overhang sides of some of the isolated boulders. At 273 m -- climbing a slight slope. At 272 m -- scattered pebble-boulder field, the number of large boulders seems to have decreased. Some boulders have clean surfaces; others are silt covered. Shell hash is comprised mainly of gastropod shells. Scattered star fish (5 - 6 cm in diameter, white colored).

270 m -- isolated 1 m+ boulders. Large encrusting white sponges on overhang sides of boulders. Large columnar white sponges, about 30 cm high (castle sponges). The number of medium-large brittle stars and small white starfish increased. Boulders, scoured on all sides; scattered sea urchins. Time 16:41 -- amount of life has decreased in numbers although the diversity remains constant. Brittle stars scattered in all sizes. The number of white anemones has decreased, now only scattered. Brittle stars becoming smaller in size (1 - 2 cm wide body); scattered white star fish (5 cm diameter) and pycnogonid Collosendea. Some shell debris. Back into big brittle stars (robusta); small white mushroom sponges. Huge boulders -- epilithics reside on the downcurrent side. The numbers of the different species is steadily decreasing. Mud volcanoes (? polychaete fecal mounds).

270 m -- large sponges -- free-standing castle type, with attached basket star; small brittle stars in densities of 2-3 / m^2 ; Isolated boulders in a pebble field. Diversity of fauna is steadily decreasing; scattered gastropod shells, Scattered medium-size sea urchins (5- 6 cm diameter) -- both dead and alive; small retractable white polychaetes (1 - 2 cm high), scattered about; small mushroom sponges. Blue encrusting sponge on rocks (2 rocks collected with the Bionic arm).

273 m - possible brachiopod -- time 17:00 -- sun star; basket star; few Alcyonaceans; few medium size brittle stars. Diversity very low and abundance is also very low. The bottom appears to be more muddy between the coarser clasts. Number of branching Alcyonaceans appears to be increasing. Isolated crinoids and basket stars on attached boulders. Gastropod shell debris common littering the seafloor. Large white (30 cm across) star fish.

268 m -- Pebble-boulder field -- some clasts are bare and not silt covered. Few sponges of the castle and mushroom variety; some encrusting white sponges on the overhangs of boulders; Small pebbles scattered about. Once we left the large boulders, the diversity and abundance of life decreased markedly. Most of the large boulders are now gone -- only scattered cobbles. Muddy covered bottom with boulders and pebbly scattered about. Basket star, scattered brittle star on the sea floor. Diversity and abundance very low.

266 m; time 17:18 Now every major rock has a basket star or attached crinoid. Shell debris becoming more common.

269 m; time 16:80 --- few small fish, nestled among the large boulders; more scattered shell debris, comprised of gastropod, bivalve, clam and *Macoma* shells. Few red and a few white 5 - 6 cm or so wide star fish; sea urchins, medium size brittle stars scattered about. Large boulders have attached basket stars and crinoids. ≈15 minutes later -- few pink anemones. More barren now. Buried brittle stars, a few Alcyonaceans. Scattered retractable white polychaetes.

265 m; time 17:24 -- large boulder meters across with attached basket stars, Alcyonaceans. Sea spiders pycnogonid *Collosendea*. Blue encrusting sponge on cobbles and boulders. At 17:52 -- basket stars became more pronounced the rest of the fauna is pretty much the same. The number of large boulders decreased, with a concommitant increase in the proportion of finer sediment on the seafloor as infill between the larger clasts. Alcyonaceans, few medium size brittle stars; sun star (6 cm across), few sea urchins 6 - 8 cm across, red) ; large brittle stars in densities of 4 - 5 / m^2 ; small white star fish (6-8 cm across). Picked up on Sonar sighting of a rock wall, 160 m away, on course directly ahead of us.

263 m; time 17:58 -- coming up a gradient, covered with boulders and shell debris -- large brittle stars in densitites of 4 - 5 / m^2 ; At 260 m; barren more sediment on the surface; isolated large brittle stars in densities of 2 - 3 / m^2 ; a few small brittle stars; occasional basket star and sponge on larger boulders; occasional polychaete plume. Boulder 1.5 m across, with attached basket star and other epilithics; climbing a slight gradient.

TAPE 2---18:05; course 205^0; depth 260 m-- coming up a gentle gradient, but with a slight current; 6 cm wide sun star; scattered large brittle stars in densities of 1 - 2 / m^2; scattered horizontal arenaceous worm tubes;

isolated large cobbles and boulders -- silt covered on top surfaces. Scattered shell debris. Bottom surface became irregular -- it is difficult to ascertain whether this irregularity is due to bedforms or boulders/cobbles which have been covered in silt; or else they are bioturbated features which have silted in. Some of the boulders are bare. Basket stars sitting on isolated boulders; white anemones in densities of 1-2 / m^2 ; large brittle stars in densities of 4 to 5/ m^2 ; few crinoids and white mushroom sponges.

Climbing to 259 m -- gentle gradient, have come up a meter. Fauna and boulder density are about the same. At 130 m horizontal distance from rock wall. The big and medium-size brittle stars have sharply decreased -- fauna diversity and density has markedly dropped off. At 249 m; time 18:14 -- rockier boulder-gravel pavement. Shell debris littered about. The pavement is comprised of all sizes of coarse debris -- gravel, cobble and boulder. Silt covering on top of some of the big clasts, most of the smaller clasts are bare. Some brittle stars, and horizontal arenaceous polychaete worm tubes; occasional crinoid. Life seems to pick up, amount of infill between the coarser particles is also increasing -- perhaps a somewhat lower current-velocity zone. Encrusting bryozoans on boulders and cobbles.

Between 243 m to 240 m: bedrock ledge; appears to be scalloped or scoured out in face looking at us -- similar to glacial gouging or large striations -- up about 3 m-- on a silt-dusted (very lightly) near vertical 70 to 90 degree slope of bedrock. On top of bedrock ramp is a topset of a 10 to 15 degree sloping ramp comprised of scattered cobbles, huge boulders with fine sediment infilling between the coarser clasts. Shell debris. Huge boulder with attached epilithics of every type that was seen on the bottom at the beginning of the dive: basket stars, encrusting sponge and bryozonas, serpulid worm tubes, etc. mainly on the undersides and overhangs of the boulder. All sizes of coarse sediment on this ledge-- from fine gravel, coarse gravel, cobble and boulder. Small brittle stars pick up markedly in density -- up to 10 - 20 / m^2 ; isolated crinoids, basket stars; mushroom sponges.

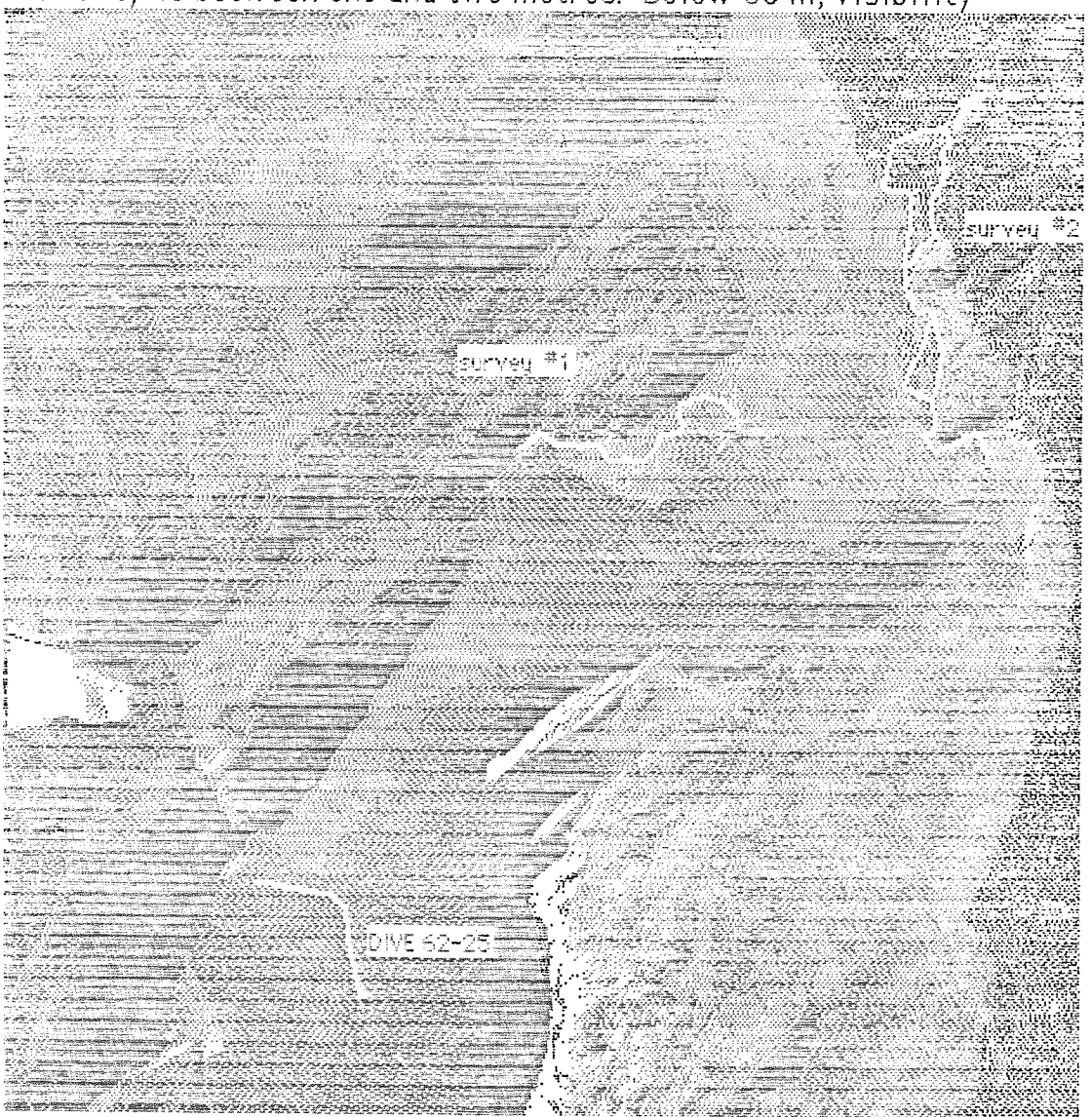
At 225 m; time 18:19 -- Bedrock ledge -- 1 to 2 m high; on top is a ramp of silt-covered scattered boulders and cobbles. Fauna is less abundant than on the previous ramp just below us (between 240 and 225 m). Scattered basket stars, Alcyonacean, small brittle stars and a few crinoids on this upper ramp. At 221 m; time 18:20 -- gradient levels off at the top of the ramp. 18:20 SURFACE

McBETH FIORD

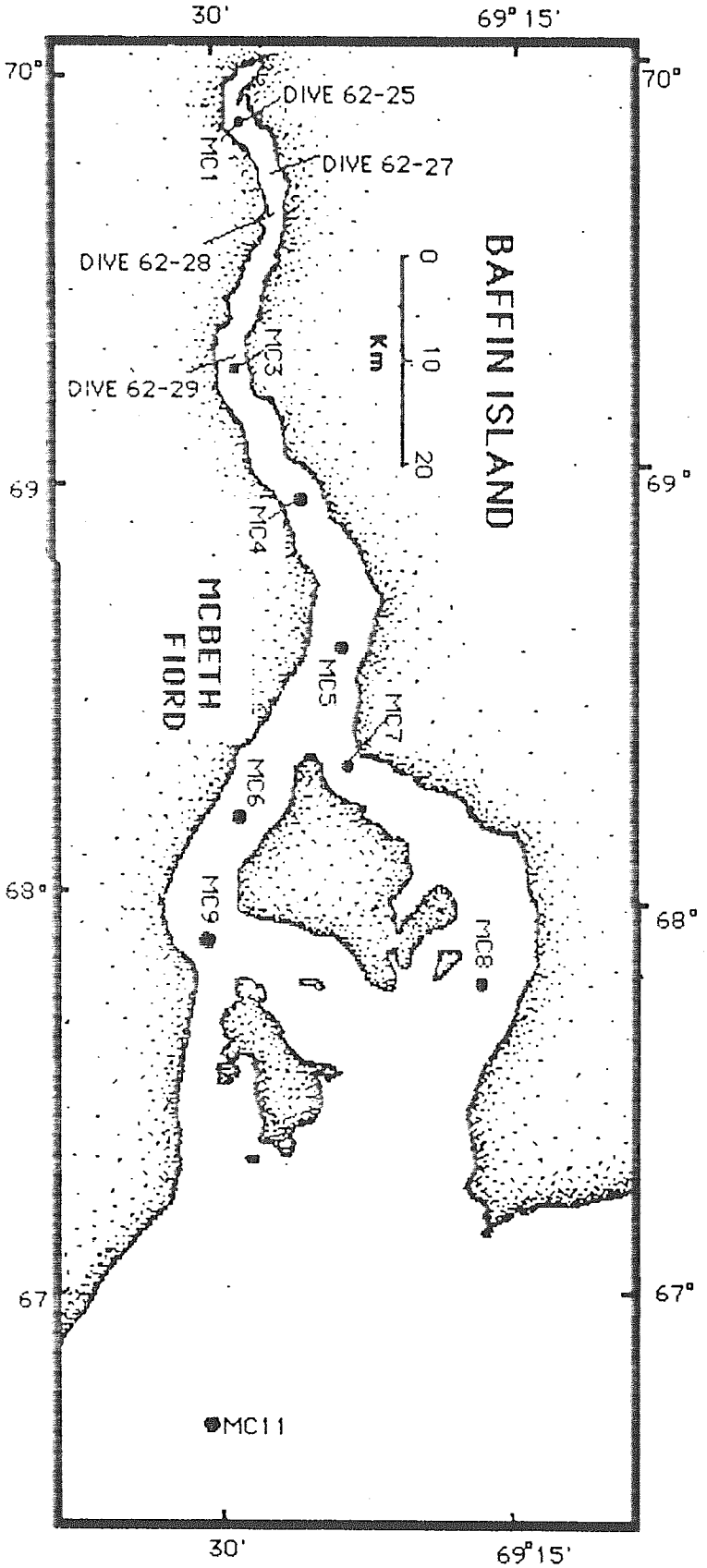
DIVE 85-062-25:1681 HEAD OF McBETH FIORD [FAILURE CROWN]
SCHAFER / GILBERT / CHAMBERS
SEPT.16,1985: 09:00 - 10:42

The objective of this dive was to locate and evaluate a glide block feature observed on the side scan sonar record. The transect did not encounter the block. It started at a depth of 180 m and terminated at 15 m on the south wall near latitude 69-31.3N; longitude 69-55.5W.

SPM was especially concentrated above the 80 m isobath dropping visibility to between one and two metres. Below 80 m, visibility



McBETH FIORD


30'
69° 15'
70°
DIVE 62-25
DIVE 62-27
DIVE 62-28
DIVE 62-29
MC1
MC3
MC4
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MC6
MC7
MC8
MC9
MC11
0
10
20
Km
BAFFIN ISLAND
MCBETH FIORD
69°
68°
67°

increased, reaching about 8 m in the deepest part of the fiord basin. The SPM appeared to be primarily small, inorganic, uniformly distributed particles with no indication of significant numbers of flocs or stringers.

The bottom sediment consisted of sandy silt that was punctured by numerous worm burrows between 180 and 100 m. Above 100 m, the 2 to 3 mm diameter worm burrows gave way to occasional large (2 to 3 cm diameter) shrimp burrows (*Sabinea*?). Cobbles and boulders increased in frequency and size towards the fjord wall.

Lithothamnion algae was first observed on rock surfaces at about 40 m and dense growths of brown *Laminaria*-like algae was observed at about 20 m. The benthos in this part of the fjord consisted primarily of about three species of brittle stars (*Ophiophollis* SP.)--the small species was the most abundant, two species of star fish (e.g., *Ctenodicus*), sea anemones (especially on sloping sediments at intermediate depths; 80 to 150 m), and occasional amphipods and gastropods. Polycheates were rare throughout the transect. An algal zone consisting of a brown-coloured film on the sediment surface occurred between about 20-30 m and was sampled using the PISCES slurp sampler. While the PISCES was stopped for a fix (before turning on its course toward the fiord wall) its lights attracted small planktonic shrimp (*Mysis*?).

The bottom morphology along the transect consisted of a number of slopes and mounds (1-2 m high). Most of the slopes were about 10-20 degrees but some reached values of 40-50 degrees. The latter were confined generally to the 100 to 180 m interval. The mounds appeared to be underlain by sand and/or gravel as indicated by short core penetration characteristics, and also by submersible skid - bottom collisions that produced grinding and scraping noises.

DIVE 85-062-27:1682
HODGE / SYVITSKI / CHAMBERS
SEPT. 16, 1985: 12:30 - 14:36

The purpose of this dive was to intersect a 30m high slide failure face for the possibility of sampling exposed beds for bio-stratigraphic analysis. However very early into the dive, the pilot complained of a low power supply and we never reached the face after 600m of travelling on our course of 090^0. Thereafter we turned to climb the rock wall.

We descended 256m to the seafloor of scattered boulders partially buried

in a muddy bottom (possibly a buried rockslide). Brittle stars were partially buried. Worm tubes (Sabellid) protruded 5 to 8 cm from the sea floor in abundances of 5 to 6 /m^2. Other fauna included branching hydrozoans (white and pink in densities of 1/3 m^2), gastropods, spiders (more than previous dives), urchins, starfish and retractable white polychaetes. Fecal mounds rose 4 to 5 cm above the level floor. There were 15 to 50 finger-size hole (polychaete). By 250 m the current had changed. A number of times Buccinid gastropods were in groups of 10 or more (alive) and may account for occasional sightings of gastropod shell debris mounds. The shrimp populations was patchy in distribution. Boulder-size was variable up to 1m in diameter.

By 240m the number of retractable white polychaetes and associated holes increased. Branching hydrozoans decreased in numbers. We intersected a 10m high 25^0 muddy slope that contained boulders either mostly buried or well-covered in epilithics. At the top (229m) of the slope fecal mounds were seen up to 20 cm high. The slope began to decrease slowly suggesting a slump toe -type topography. An anemone was seen living on top of a slowly moving gastropod. Some kelp detritus littered the floor. We ended our descent at 245m. We observed quite a few dead brittle stars and urchins in association? with lots of pycnogonid spiders.

We turned to port and climbed up a steep muddy slope at 237m: brittle stars and shrimp increased, as did shell fragments and live tiny scallops; polychaete holes and infauna fecal mounds decreased. There was such a concentration of shell detritus that one wonders whether the shell hash was of recent or early Holocene/Pleistocene age?

By 167m the slope was composed of outcropping bedrock including crevasses and overhangs. The rock wall was near vertical. Initially the epilithics were low in diversity (small button sponges) and density (10%), but as the depth decreased the diversity increased (serpulids, encrusting sponges--pink, yellow and white--bryozoan) as did the density: by 97m 30 % coverage, 88m 60 % coverage, 70m 80% coverage. By 55m red rock algae *(Lithothamion)* was noted and associated with a marked decrease in other epilithic diversity (sponges) and density. Brown algae appeared on the sediment patches at 50m. *Oikopleura* appeared in the water column as a sharp layer at 45m. Also at 45m the number of scallops and other bivalves appeared in great numbers. By 40m, bioclastics composed 50% of the surface mud.

DIVE 85-062-28: 1683 McBETH FIORD (INNER SILL)
SYVITSKI / ASPREY / TAYLOR
SEPT. 17, 1985: 09:00 - 11:25

The purpose of this dive was to investigate a sill found during previous cruises and to collect evidence on whether it was a glacial feature or bedrock. We began our slow decent to the bottom in ≈ 183 m of water. The water column contained rather light SPM but concentrations of *Oikopleura* was high. Once on the bottom, current speed was estimated to about 1/2 knot setting 300^0 and visibility was good at several metres. The submersible took a course of 120^0 T. for ≈ 3 cables. Along this traverse the bottom remained fairly constant: a muddy sand with a high density of pebbles and boulders ranging from cobbles to boulders. These rocks appeared well covered in epilithics or partly buried (well-established). We initially climbed a gentle incline from 183 to 155 m. Thereafter we traversed a very hummocky terrain (± 2 m). The bottom benthos slightly changed with the amount of gravel: in some areas the bottom was very muddy with a high density of infauna. Sometimes the boulders showed scour at their downslope sides; others should lots of deep holes of unknown origin.

The rocks were encrusted with a blue sponge, crinoids and brachiopods?. The bottom contained brittle stars, the occasional basket star, sea anemones, branching hydrozoans, polychaetes *(Sabellid)* and urchins. At the end of this traverse we had descended to 164 m, Pisces asked the surface for a fix but unfortunately the positioning system was not working properly. Pisces turned on a new course of 255^0 T. This course should have carried us up the face of the sill, but only seemed to take us into deeper water: the course was again altered to 230^0 T. We climbed more or less steadily after that.

At 115m sea urchins appeared and shrimp increased. The matrix was very sandy between the coarser sediment. Retractable white polychaetes were 3 to 8 /m^2. Basket stars appeared above 85 m. The terrain became even more hummocky (h=4 to 5 m). As expected the crests were coaser and the troughs were finer-grained. Brittle stars were greatest on the slopes and reached 30 /m^2. In one area a lot of large holes were found (diameters of 20 to 30 cm). Is it possible that these holes may be part of a local dewatering zone (submarine spring)? By 70m the benthos consisted mostly of epifauna.

At 66m we ran along the first of a number of sinuous sharp-crested ridges of angular cobbles and boulders (the top of a terminal frontal-dump moraine). The crests were so sharp that the seafloor fell off on both the starboard and port viewports. The crests had large growths of branching hydrozoans, many sea urchins 5 / m^2. Between the crests were 2m deep troughs partly covered in a winnowed sandy mud. At 50m red algae appeared on the rocks. We surfaced through the *Oikopleura* layer whose lower limit in the water column was 43m.

DIVE 85-062-29:1684 McBETH DEEP BASIN AND FIORD WALL
HEIN / SCHAFER / TAYLOR
SEPT.17,1985: 13:10 - 16:00

The objective of this dive was to evaluate the bottom morphology and sediment texture of a 400 m-deep central fiord basin near latitude 69^0 31.3'N; longitude $69^0$19.0'W. The traverse was run from a point just south of the middle of the basin on a course of 360 true until the fiord wall was encountered (350 m ?) and then vertically to a depth of about 15 m.

Water column characteristics include a zone of *Oikopleura* down to about 60? m and a trend of increasing floc size and stringer length and frequency with water depth. Visibility was about 2 to 3 m at the start of the dive (≈400 m) due to increased concentrations of very fine SPM, compared to a value of about 10 m throughout the *Oikopleura* zone.

Sediments on the basin floor supported a sparse fauna of brittle stars and retractable white polychaetes. One cm diameter burrows were common on the basin floor; they gave way to 2 to 5 cm diameter burrows at about 370 m. These larger burrows were occupied by a 3 to 4 cm long reddish coloured species of shrimp. The basin floor morphology along the transect was marked by several 2-6 m amplitude undulations that may be evident on the side scan record. The base of the fjord bedrock wall was encountered at about 350(?) m and was essentially near vertical to a water depth of about 40-50 m where it gave way to a gravel covered narrow (100 m) shelf with about a 20 degree slope. *Lithothamnion*-covered gravel and empty bivalve shells are transported down the cliff face from this source area often coming to rest on small (several m wide) shelves that occur along the axis of rock channels. These V-shaped channels are the product of a set of approximately 90 degree intersecting fractures and form conduits that transport gravel and shell debris to the very base of the wall face.

Other joint planes are nearly vertical or dip into the wall face resulting in numerous overhanging faces that are effectively isolated from the ambient rain of SPM. These niches have been colonized by a variety of organisms including encrusting worms, algae, sponges, crinoid-like forms, scallops, and anemones. These surfaces are distinctly dark in colour compared to their sediment covered counterparts.

INUGSUIN FIORD

DIVE 85-062-31:1685 WESTERN SILL ENTRANCE: INUGSUIN FIORD
SCHAFER / GILBERT / WITCOMBE
SEPTEMBER 18, 1985: 09:00-11:00 ADT

In general, the benthic fauna observed at the entrance to Inugsuin Fiord was comparatively diverse. It included brittle stars, mud(?) shrimp, polychaetes, gastropods and shrimp. There were numerous occurrences of red coloured shrimp occupying shallow inclined burrows of about two to four cm in diameter.

Navigation during this particular dive was complicated by an incorrect gyro setting. The actual track curves southwest. The course run (Pandora plot) was 340 true rather than the intended course of 160 true which would have taken the PISCES onto the outer sill of the fiord.

Bottom sediments along the traverse appeared to be regionally homogeneous (clayey? silt); their surface was marked by epifaunal (brittle star and gastropod) tracks. Some local areas of the bottom were littered with randomly oriented abandoned polycheate worm tubes. There was no bedform evidence of bottom currents. Comparatively large numbers (3 to 4 per 10 square metres) of small bulbous-headed fish were noted lying on the bottom or occupying shrimp burrows over the entire transect.

SPM appeared to be relatively fine and dispersed at 18 m; some small flocs and stringers were evident at 27 - 30 m. *Oikopleura* began to decrease in number at about 40 m concommitant with an increase in the density of sediment stringers. At 100 m , *Oikopleura* concentrations had decreased, zooplankton densities were higher and sediment stringer size (i.e., length) was down to less than one cm. At 200 m , there was an increase in floc density (most SPM appeared to be in floc form) and *Oikopleura* were relatively sparse. At 250 m , the diversity of zooplankton showed a distinctive increase, pteropods were common, floc sizes were of intermediate diameter compared to those observed at shallower depths, occasional stringers were present and visibility was about 3 - 5 m.