1988 CANADIAN BEAUFORT SEA COAST SURVEY

FIELD SURVEY REPORT (Cruise Report No 88310)

5 August - 19 August 1988

Canadian Beaufort Sea Coast
Eastward of the Mackenzie Delta

by Arnaud HÉQUETTE (EMG)

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STUDY AREA:

Canadian Beaufort Sea Coast, eastward of the Mackenzie Delta (i.e. from North Head, Kugmallit Bay coast, and northwestern coast of Tuktoyaktuk Peninsula) (Fig. 1).

OBJECTIVES:

1) To collect stratigraphic data concerning recent and Late Holocene relative sealevel changes:

- Coring in barrier islands and spits along the Kugmallit Bay and Tuktoyaktuk Peninsula coastline to obtain lithostratigraphic data and possibly organic material for radiocarbon dating.

- Coring in tidal marshes along the Kugmallit Bay and Tuktoyaktuk Peninsula coastline to reconstruct the Holocene sedimentary environments (particularly the transition from freshwater to brackish/marine conditions).

2) To survey recent geomorphological changes for a study of coastal stability and modern coastal processes:

- Resurvey cliff retreat measurement sites.

- Establish new erosion bench marks along the coast, from North Head to Cape Dalhousie, to complement the existing erosion measurement sites.

SCIENTIFIC STAFF:

- Arnaud Héquette (AGC)

- Marie-Hélène Ruz (Field Assistant)

EQUIPMENT:

- Portable vibracorer (from Dalhousie University)

- CRREL Coring Auger for frozen ground (from Technical Field Support Services, EMR)

- Theodolite with tripod and rod (from Technical Field Support Services, EMR)

RESULTS:

1) Coring:

12 core samples were collected with either the Dalhousie vibracore or the CRREL Coring Auger (see Appendix). The Dalhousie vibracorer was most succesful in collecting undisturbed core samples but had poor penetration capability because of proximity of permafrost below the ground surface. Deeper cores were collected with the CRREL Coring Auger; a 181 cm long core was collected in a marsh 7 km north of Tuktoyaktuk. The main problems with the CRREL Coring Auger are the length of time necessary to operate the auger and to collect samples, and the fact that subsamples have to be extruded and collected on site.

Several cores in peat beds, possible lagoonal or glacial sediments, have been collected. In some

of them, the complete marsh sequence may have been collected and should therefore give valuable information regarding paleosealevels. The cores have been subsampled for palynology, mineralogy, salinity, and grain-size analyses; results of these analyses will help in defining sedimentary environments before submitting organic material fordating to constrain sea level changes.

2) Coastal retreat measurements:

15 new bench marks were installed from the Kugmallit Bay coast to Liverpool Bay to mesure cliff erosion(see Appendix). 5 retreat measurement sites were resurveyed in the Toker Point area. Resurveying in 1988 revealed retreat rates ranging from 2.75 to 11.55 m/a, thus confirming previous rapid erosion rates along this coast.

DAILY LOG:

5 August: Arrival in Tuktoyaktuk at 19:00.

6 August: Reconnaissance trip along Tuktoyaktuk Peninsula, from Tuktoyaktuk to Phillips Island (northeast of McKinley Bay). Test-coring with hand auger for selecting appropriate sites for vibracoring.

7 August: Vibracoring in Tibjak Spit. Several unsuccessful attempts in backbarrier-lagoon area and barrier crest. Only sandy overwash deposit with minor gravel (surficial barrier sediment) encountered. On the barrier crest, the vibracorer always stopped at 5 ft below the surface (possibly depth of permafrost table).

8 August: Topkak Spit. Problems with motor during vibracoring attempt. One small core (ca 40 cm) recovered from edge of lagoon marsh, at ca 30 cm below maximum high water level. The core was extruded on site. Upper few centimetres of core are medium sands with marsh plants and roots covering finer, organic-rich, black sands with wood fragments. These are underlain by ca 30 cm of medium to coarse sands. This section is interpreted, from bottom to top, as a backbarrier beach environment overlain by high water level debris (driftwood). A thin marsh is now developing on top, probably because this area is more frequently flooded. No sampling in this core.

Two bench marks were installed in the dunes on the central part of the spit. Bench mark AGC 88-1, a wooden log in upright position, was located near the edge of the northernmost marsh, and identified by fluorescent orange paint and fluorescent tape with corresponding number. The distance to the edge of the dune cliff was 23.5 m, in a direction perpendicular to the coast.

Bench mark AGC 88-2 consisted of two wooden stakes located near the edge of the same marsh, near the northern limit of the dunes of the spit. The two wooden stakes were aligned perpendicular to the coast and were identified by fluorescent orange paint and fluorescent tape with numbers AGC 88-2A and AGC 88-2B. AGC 88-2A was 33.4 m from the edge of the dune cliff; AGC 88-2B was 39.3 from the edge of the cliff. Coastal dunes at that location are migrating landward rather than being eroded.

Afternoon: back to Tuktoyaktuk to fix the vibracore motor and to clean equipment.

9 August: Bad weather with storm surge estimated higher than 1 m. Water level too high for coring so we resurveyed coastal erosion markers along the cliffs near Toker Point. The 4 markers were found. The failure of blocks composed of a thin sand veneer (ca 1 m) overlying massive ice, up to 20 m high, suggested recent severe erosion.

Afternoon on Tibjak Spit. Resurveyed erosion bench mark on cliff, north of spit. Stakes for the first of three beach profiles were not found. The other beach profile bench marks were found, but profiles were not surveyed because of high waves reaching the upper beach. Only the distance from stakes to the edge of dune cliff was measured.

10 August: Three cores were collected near the outer edge of Topkak marsh. C 88-1 was 60 cm long; permafrost table was 84 cm below the ground surface at that site. The two other cores were extruded on site and sampled. C 88-2 was 36 cm long and permafrost was at a depth of 48 cm. The third core (C 88-3) was 60 cm long; frozen "chips" began to occur in the sediment at 40-45 cm below surface in this core. All cores were tied to the still-water level with a theodolite.

A section near an island in Topkak Marsh (C 88-4) was logged and sampled. Bottom of the section was a frozen wood log (storm debris) overlain by 20 cm of desaggregated wood fragments. A 20 cm thick black peat soil had developed on top. This soil was overlain by 8 cm of desaggregated wood. The next sequence was a 15 cm thick grey sandy-silt deposit with little vegetation. The top of the section was a 7-8 cm soil, similar to the buried soil. The present day maximum surge limit with driftwood logs is 1.5 m higher than the wood log in the section. Assuming storm surges of similar intensity, the log in the section is interpreted to have been deposited when the sea level was ca 1.5± 0.8 m lower than the modern mean sea level (the error was estimated by adding the difference in elevation between the two modern surge debris lines (40 cm) to a possible variation in storm surge elevation of ca 40 cm). This former surge debris has probably been deposited on the tundra surface. As with modern debris lines, driftwood fragments were deposited and desaggregated; then a soil began to develop. With the subsequent sea level rise, this area was more frequently flooded by calm water and fine sedimentation began to occur with minor development of marsh vegetation. The development of a soil on top shows that this level is less frequently reached by the sea because of vertical aggradation and possibly because of more protection by the prograding Topkak spit.

11 August: Toker Point marsh. Core C 88-5, 50 cm long + 18 cm of soil with silty mud (sample C 88-5A). Core located near the outer edge of the marsh. Permafrost table at 74 cm. Core C 88-6 collected in the inner part of the marsh; extruded and sampled on site. **43???**cm long + 20 cm of soil. Core from top to bottom was 25 cm of dark grey silty mud, 15 cm of dark peat, and 10 cm of silty peat (bottom is frozen).

Unsuccessful attempt to core in Tuft Point spit: we only collected 80 cm of sand. Erosion bench marks were put on top of the cliff east of Tuft Point. AGC-88-3 was a wooden stake with orange paint, located in the western part of the dunes on top of the cliff, at 51 m from cliff edge. AGC-88-4 was ca 150 m eastward, 23.2 m behind a wood cross in the dunes, and was 49.9

m from the cliff edge.

A 75 cm long core (C-88-7) was collected on small island near mouth of Kukjuktuk Bay, on the marsh edge of the lagoon in the central part of the island. 105 cm of tube in the ground but permafrost not reached.

12 August: Drift Point. One 70 cm long core (C-88-8) collected in the marsh, ca 500 m behind the spit.

A vertical exposure was sampled in coastal dune near Drift Point (C-88-9): recent coastal dune (C-88-9A) overlying soil (C-88-9B) and older dune (C-88-9C) which was underlain by 5-10 cm thick peaty soil. Permafrost and ice-bearing sediments at the base of the section, below the lower soil.

Erosion bench marks were put on top of the cliff west of Drift Point. AGC-88-5 was located ca 20 m westward of the coastal dunes, at a distance of 50 m from the cliff edge. AGC-88-6 was located within the Drift Point coastal dunes complex, at 50.5 m from the cliff edge.

Dunes appears to be migrating inland (burial of tundra).

13 August: Erosion bench mark AGC-88-6b was established east of Toker Point, on the east side of Mingnuk Bay; distance 36.9 m from cliff edge. Cliff composed of ca. 80% massive ice.

Erosion bench mark AGC-88-7, west of Warren Point, installed at 51.05 m from cliff edge. 10-15 m high cliff affected by block failure.

Erosion bench mark AGC-88-8 installed at Warren Point. Iron rod identified by "Legal Survey Marker" in backshore dunes; distance 73 m from low scarp on the seaward-facing side of the dunes.

Erosion bench mark AGC-88-9 installed in coastal dunes located on small peninsula in Hutchison Bay. The bench mark was located 51.5 m from the eroding dune cliff (2-3 m high), in the midle part of the small coastal dune field.

Erosion bench mark AGC-88-10 installed at Atkinson Point, 30 m west of beacon tower. The bench mark (iron rod) was located 25.3 m from the eroding dune cliff (1 m high).

Erosion bench mark AGC-88-11 installed on the eastern shore of McKinley Bay (orange painted iron rod); distance 38.8 m from the cliff edge (1.5 m high).

Erosion bench mark AGC-88-12 installed on the eastern shore of McKinley Bay (orange painted iron rod), southward of AGC-88-11; distance 44.2 m from the cliff edge (12 m high).

14 August: North Head. One 90 cm long core (C-88-10) collected in the backshore, near landward limit of washover fans, in the proximal part of the spit near small marsh.

A 51 cm long core (C-88-11) collected in the backshore of a small gravel spit near the mouth of Canyanek Inlet (south of Kugmallit Bay). Core collected in the upper marsh, 10 m inland from washover fans.

15 August: Mounting and testing the CRREL Coring Auger. Satisfactory results; plan to use it next day in Topkak marsh.

16 August: A 181 cm long core (C-88-12) collected in Topkak marsh with the CRREL Coring Auger. Permafrost reached at a depth of 40 cm below the ground surface. 7 subsamples collected through the core (see Appendix for description). Modern marsh deposits overlie possible lagoonal sediments (grey mud) underlain by probable diamicton (brown mud). If the complete lagoon/marsh sequence has been sampled, radiocarbon dating should provide good control on late Holocene sea level rise.

59 cm long core (C-88-13) collected with the vibracorer in the upper part of the Topkak marsh.

One check sample (TM-88A) of glacial till (brown clayey diamicton) collected in the scarp located near the landward limit of the marsh.

17 August: Low-level survey of the northern coast of Tuktoyaktuk Peninsula and Cape Bathurst Peninsula. One erosion bench mark (AGC 88-13) was installed on an island on the west side of Russell Inlet. This was a wood stake with fluorescent paint, located 57.2 m from the edge of a 10 m high sandy cliff with occasional ice wedges. A second bench mark (AGC 88-14) installed on an island on the eastern side of Russel Inlet, was an orange iron rod, located 47.3 m from the edge of a 12 m high sandy cliff with ice wedges.

Investigations on Cape Bathurst Peninsula; visiting sections of Quaternary deposits described by Rampton (1988) near Maitland Point (C-88-14). Logging and subsampling.

18 August: Packing and preparing equipment and samples for trip back to Halifax (N.S.).

19 August: Departure from Tuktoyaktuk.

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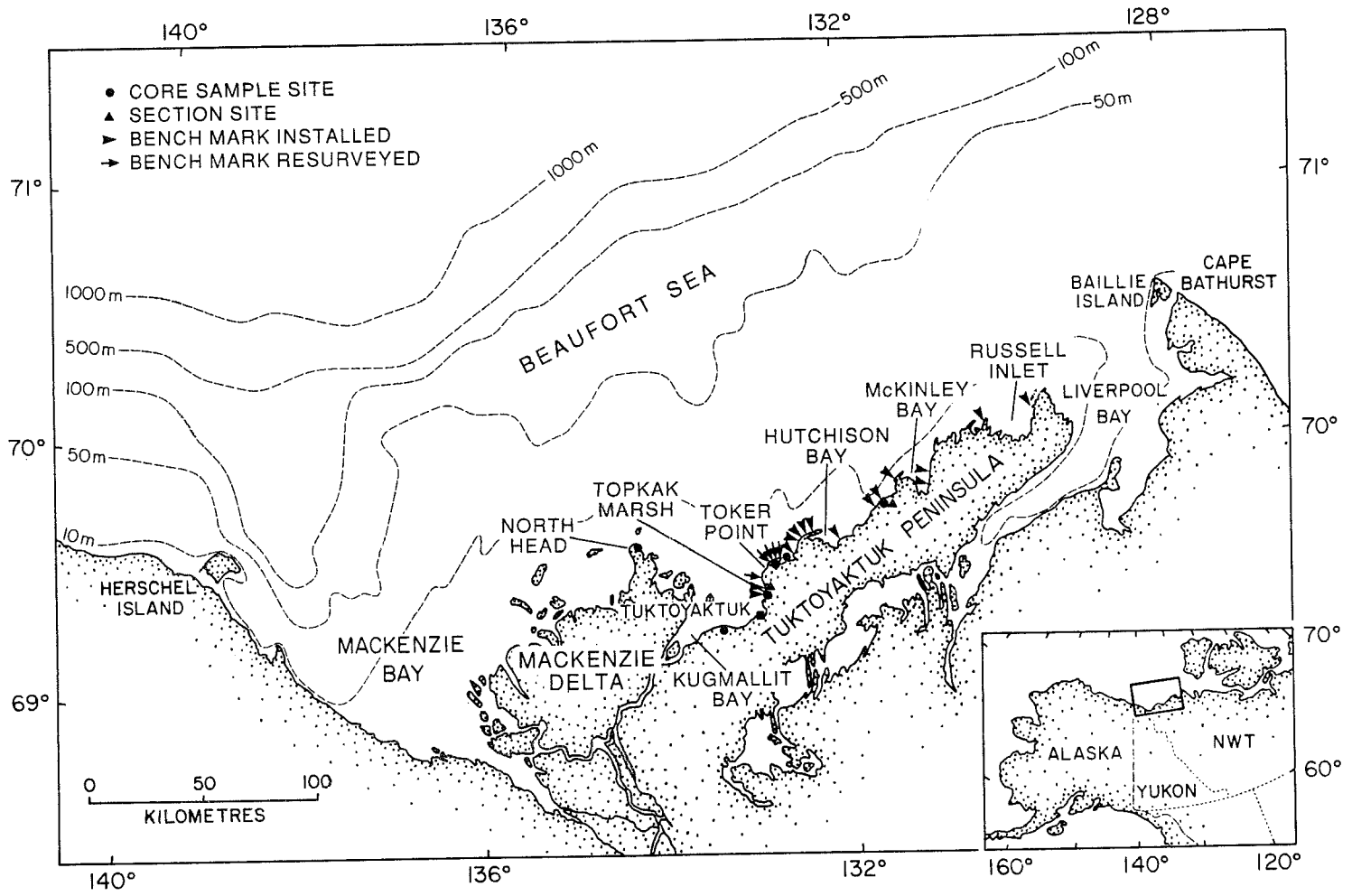

Figure 1. Location map of study area

APPENDIX

TUK 88 - Core Log
TUK 88 - Core Sample Log
TUK 88 - Cross-section Log
TUK 88 - Cross-section Sample Log
TUK 88 - Erosion Bench Marks

TUK 88 - CORE LOG

No.	Day	Location	Latitude	Longitude	Notes
C88-1	223	Topkak Marsh	69° 30′ 34″	132° 57′ 24″	
C88-2	223	Topkak Marsh	69° 30′ 30″	132° 57′ 24″	sampled on site
C88-3	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	sampled on site
C88-5	224	E. Toker Pt.	69° 39′ 00″	132° 48′ 36″	
C88-6	224	E. Toker Pt.	69° 39′ 00″	132° 48′ 30″	sampled on site
C88-7	224	Kukjuktuk Bay Island	69° 39′ 00″	132° 41′ 12″	
C88-8	225	Drift Pt. Marsh	69° 52′ 00″	131° 37′ 00″	
C88-10	227	North Head	69° 43′ 24″	134° 23′ 00″	Backbarrier lagoon
C88-11	227	Canyanek Inlet	69° 23′24″	133° 23′ 00″	Backbarrier lagoon
C88-12	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	sampled on site
C88-13	229	Topkak Marsh	69° 30′ 48″	132° 55′ 48″	
BH-5	235	North Head Spit	69° 43′ 28″	134° 22′ 45″	tip of the spit

TUK 88 - CORE SAMPLE LOG

No.	Day	Location	Latitude	Longitude	Notes	Depth (cm)
C88-2A	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	peat	20
C88-2B	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	mud	30
C88-3A	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	peat	10
C88-3B	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	grey mud	23
C88-3C	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	mud	31
C88-3D	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	mud	37
C88-3E	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	frozen mud	45
C88-3F	223	Topkak Marsh	69° 30′ 36″	132° 57′ 42″	brown frozen mud	55
C88-5A	224	E. Toker Pt.	69° 39′ 00″	132° 48′ 36″	upper soil	9
C88-6A	224	E. Toker Pt.	69° 39′ 00″	132° 48′ 30″	mud	32
C88-6B	224	E. Toker Pt.	69° 39′ 00″	132° 48′ 30″	peat and mud	51
C88-6C	224	E. Toker Pt.	69° 39′ 00″	132° 48′ 30″	mud	61
C88-12A	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	peat	39
C88-12B	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	frozen grey mud	76
C88-12C	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	frozen grey mud	97
C88-12D	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	frozen grey mud	125
C88-12E	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	frozen grey mud	147
C88-12F	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	frozen brown mud	161
C88-12G	229	Topkak Marsh	69° 30′ 30″	132° 57′ 36″	frozen brown mud	175

TUK 88 - CROSS-SECTION LOG

No.	Day	Location	Latitude	Longitude	Notes
C88-4	223	Topkak Marsh	69° 30′ 24″	132° 57′ 06″	sampled on site
C88-9	225	Drift Pt. (Dune)	69° 52′ 12″	131° 37′ 00″	sampled on site
C88-14	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	sampled on site

TUK 88 - CROSS-SECTION SAMPLE LOG

No.	Day	Location	Latitude	Longitude	Notes	Depth* (cm)
C88-4A	223	Topkak Marsh	69° 30′ 24″	132° 57′ 06″	soil	6
C88-4B	223	Topkak Marsh	69° 30′ 24″	132° 57′ 06″	mud	20
C88-4C	223	Topkak Marsh	69° 30′ 24″	132° 57′ 06″	wood fragments	30
C88-4D	223	Topkak Marsh	69° 30′ 24″	132° 57′ 06″	peat	40
C88-4E	223	Topkak Marsh	69° 30′ 24″	132° 57′ 06″	organic and wood	60
C88-9A	225	Drift Pt.	69° 52′ 12″	131° 37′ 00″	dune sand	150
C88-9B	225	Drift Pt.	69° 52′ 12″	131° 37′ 00″	buried soil	300
C88-9C	225	Drift Pt.	69° 52′ 12″	131° 37′ 00″	old dune sand	377
C88-9D	225	Drift Pt.	69° 52′ 12″	131° 37′ 00″	peaty soil	420
C88-14A	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	compact mud	700
C88-14B	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	mud and sandy beds	600
C88-14C	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	mud and sandy beds	450
C88-14D	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	peat soil	370
C88-14E	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	mud and sand	330
C88-14F	230	S.E. Ikpisugyuk Pt.	70° 7′ 36″	128° 04′ 00″	thinly bedded	150
TM88-A	229	Topkak Marsh	69° 30′ 48″	132° 55′ 48″	soil	20

* Depth is from top of section

TUK 88 - EROSION BENCH MARKS

No.	Day	Location	Latitude	Longitude	Distance from Cliff Edge
AGC-88-1	221	Topkak spit	69° 30′ 36″	132° 59′ 36″	23.5 m (Dune cliff)
AGC-88-2	221	Topkak spit	69° 30′ 42″	132° 59′ 48″	33.4 m (Dune cliff)
AGC-88-3	224	E. Tuft Pt.	69° 43′ 24″	132° 33′ 00″	51 m
AGC-88-4	224	E. Tuft Pt.	69° 43′ 48″	132° 33′ 48″	50 m
AGC-88-5	225	Drift Pt.	69° 52′ 00″	131° 38′ 00″	50 m (Dune cliff)
AGC-88-6	225	W. Drift Pt.	69° 51′ 36″	131° 39′ 00″	50.5 m
AGC-88-6bix	226	E. Mingnuk Pt.	69° 40′ 24″	132° 38′ 12″	36.9 m
AGC-88-7	226	W. Warren Pt.	69° 44′ 30″	132° 28′ 24″	51 m
AGC-88-8	226	Warren Pt.	69° 45′ 00″	132° 22′ 12″	73 m (Dune cliff)
AGC-88-9	226	Hutchinson Bay	69° 43′ 24″	132° 05′ 22″	51.5 m (Dune cliff)
AGC-88-10	226	Atkinson Pt.	69° 56′ 54″	131° 26′ 30″	30 m (Dune cliff)
AGC-88-11	226	E. McKinley Bay	69° 55′ 54″	131° 04′ 24″	38.8 m
AGC-88-12	226	E. McKinley Bay	69° 53′ 24″	131° 05′ 24″	44.2 m
AGC-88-13	230	W. Russel inlet	70° 08′ 24″	130° 33′ 54″	57.2 m
AGC-88-14	230	W. Russel inlet	70° 12′ 56″	129° 50′	47.3 m
AGC-87-3	222	Tibjak	69° 36′	132° 58′ 38″	23.3 m