Description of dataset “Subaquatic ambient seismic noise recordings acquired in the region of Inuvik and Tuktoyaktuk, Northwest Territories, Canada”

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Abstract
This dataset contains subaquatic passive seismic recordings taken in September 2021 at 88 locations off Tuktoyaktuk Island as well as in a small lake (“Lake 3”) between the villages of Tuktoyaktuk and Inuvik, Northwest Territories, Canada. The measurements were part of the “Mackenzie Delta Permafrost Field Campaign” (mCan2021) within the “Modular Observation solutions for Earth Systems” (MOSES) program. Data is from a seismic intermediate-bandwidth seismic sensor lowered for few minutes to the bottom of the sea and lake, respectively, and from underwater short-period sensors deployed for a few days. The aim of the study was to determine the depth of the subaquatic permafrost (local lake and oceanic locations). Raw data is provided in proprietary “Cube” format and standard mSEED format.

Coordinates: 69.456N/ 133.003W and 68.776850N/ 133.540817W
Keywords: Submarine permafrost, ambient seismic noise, H/V measurements, Mackenzie Delta

1. Introduction

Ambient seismic noise measurements at the shallow sea bottom proved to be useful for estimating the spatial distribution and depth of submarine permafrost, in particular in combination with H/V analysis (ratio of horizontal and vertical components of noise recordings; Overduin et al., 2015). The data contained in this data set (ambient seismic noise data at the shallow sea floor off Tuktoykatuk Island and in a lake ~100 km south of it (“Lake 3”), Northwest Territories, Canada) were acquired during the 2021 “Mackenzie Delta Permafrost Field Campaign” (mCan2021), a test campaign within the “Modular Observation solutions for Earth Systems” (MOSES) program. The dataset is complementing/extending the dataset obtained by Ryberg et al. (2019). See also Cable et al., 2019. Also, CH4 and CO2 measurements, electrical resistivity and temperature investigations had been carried out in the study area.

2. Data Acquisition – Experiment, schedule, acquisition parameters

2.1 Experiment design and schedule

Subaquatic ambient seismic noise measurements were carried out around Tuktoyaktuk Island and in a small lake between the villages of Tuktoyaktuk and Inuvik (Northwest Territories, Canada). In total 88 measurements points were taken in September 2021 (see Figure 1 & 2, Table 1 in supplement and file *HV.dat* in the data – see below). The measurements were taken point by point from small boats. At each point the sensor was lowered to the lake or sea bottom, where it stayed for several minutes (see Table 1 in supplement). Additionally, long-term recordings (few days) were taken at 4 locations by shallow water ocean bottom seismometers (OBS).

2.2 Instrumentation

To record the ambient seismic wave field the “Mobile Ocean Bottom Seismometer” (MOBSI) system was used (see Figure 3). The system consists of 1) an intermediate bandwidth seismic sensor (type Nanometrics Trillium Compact 20 s seismometer) housed – together with a Omnirecs/DiGOS Cube digitizer - in a watertight casing, 2) a manual winch with 100 m steel cable, and 3) a surface data acquisition unit with a small computer. The MOBSI system allows real-time quality data control as well as control of the tilt of the sensor.
Furthermore, we used 4 shallow water seismic recording units (OBS, based on Omnirecs/DIGOS.

Cube digitizer and a 3-component 4.5Hz short-period geophone in a watertight casing) for recordings of several days (equipped with anchor and buoys; Figure 4). Exact timing of these units was provided by synchronizing the internal clock to a GPS device before and after the measurements.

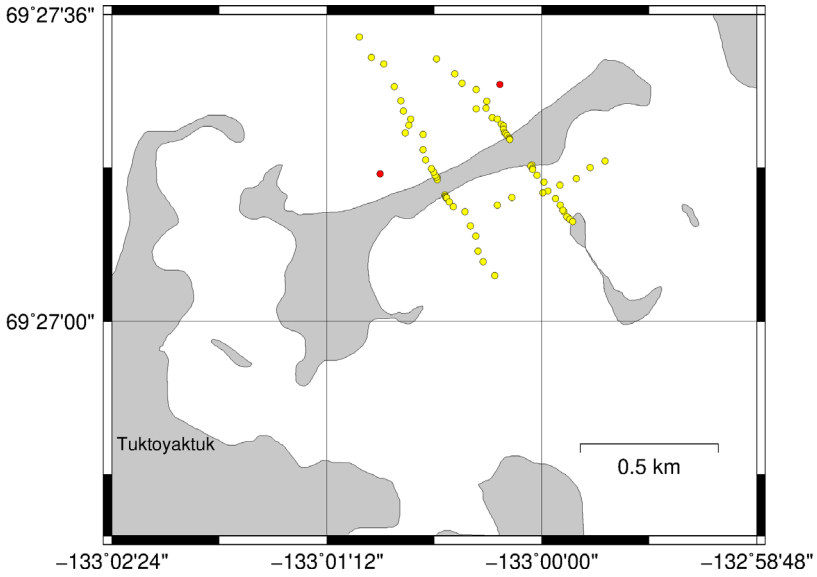

Figure 1: Study area close around Tuktoyaktuk Island, Northwestern Canada. Yellow circles denote the locations of ambient noise measurements with MOBSI (short time), red circles those from long-term deployments.

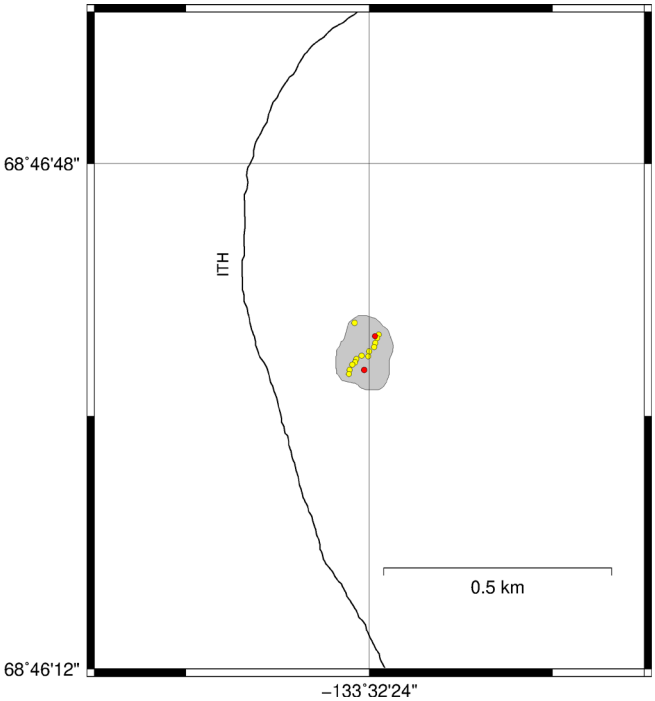

Figure 2: Study area at „Lake3“ at the Inuvik-Tuktoyaktuk Highway (ITH), Northwestern Canada. Yellow circles denote the locations of ambient noise measurements with MOBSI (short time), red circles those from long-term deployments. Grey line is the IT.

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2.3 Acquisition parameters

For data acquisition a sample frequency of 100 samples per second at gain 4 for MOBSI and 200 samples per second at gain 32 for the OBS were used. Data from MOBSI was marked as valid if the tilt of the seismic sensor was below 5° (operational range of intermediate-period sensor). The time windows, i.e. when the data was marked as valid (also known location), are listed in Table 1 and can be used for further processing (extraction etc.).

2.4 Coordinates & deployment depths

Positions were taken by handheld GNSS with an estimated accuracy of 3 to 5 m. Water depth was determined by an echo sounder, taken by a bathy-boat (Cable, 2022, in preparation) or from the near-by resistivity measurements (Overduin et al., 2202, In preparation).

Figure 3: “Mobile Ocean Bottom Seismometer” (MOBSI) system: cable drum (right), broad band seismic sensor & data logger (middle) and control unit/computer (left). Modified from Ryberg et al., 2018.

Figure 3: Shallow water ocean bottom seismometer. The cylinder containing the recorder and sensor is mounted on a metal grid.

fCab

3. Data Processing

For the data contained in this data set, no processing has been performed except for the format conversion using the GIPPtools (Lendl, 2021).

4. Data Description

This data set contains raw data in original Cube format and as in standard MSEED format (FDSN, 2012). Directory */raw* contains raw data in original Cube format (continuously), directory /*mseed* contains the converted MSEED data (three files types c0????2109????????.pri? for the three components; pri0 indicating the vertical component, and pri1 and pri2 the two un-oriented horizontal components, respectively). Table with coordinates etc. can be found in file */info/HV.dat*.

5. Data Availability/Access

Data is archived at the *GIPP Experiment and Data Archive* where it is freely available for further use after the end of the embargo period on October 31, 2023 under a "Creative Commons Attribution 4.0 International Licence" (CC-BY 4.0). When using the data, please give reference to this data publication. Recommended citation is:

> Ryberg, T., Haberland, C., Overduin, P., &. Cable, W. (2022) Subaquatic ambient seismic noise recordings acquired in the region of Inuvik and Tuktoyaktuk, Northwest Territories, Canada. GFZ Data Services. http://doi.org/10.5880/GIPP.202199.1

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Appendix 1: Table listing all measurement points, coordinates, depth etc. (also contained in file HV.dat in the data set, directory /info

HV#	GPSpnt	oldpnt	rec	H2O-ft	H2O	PF	long	lat	type	location	start_measurement	stop_measurement	comment
HV12	6	1	11	.	.	0.45	-133.540817	68.776850	M	L3	2021-09-14T20:03:16.000	2021-09-14T20:05:18.000	get depth from GE tracks/bathyboat/CTD
HV13	7	0	12	.	.	X	-133.539483	68.776617	M	L3	2021-09-14T20:31:26.000	2021-09-14T20:35:21.925	get depth from GE tracks/bathyboat/CTD
HV14	8	10	15	.	.	X	-133.539567	68.776550	M	L3	2021-09-14T20:39:23.000	2021-09-14T20:45:41.000	get depth from GE tracks/bathyboat/CTD
HV15	9	20	16	.	.	X	-133.539667	68.776450	M	L3	2021-09-14T20:48:37.655	2021-09-14T20:52:54.395	get depth from GE tracks/bathyboat/CTD
HV16	10	30	17	.	.	X	-133.539750	68.776367	M	L3	2021-09-14T20:57:29.000	2021-09-14T21:00:23.415	get depth from GE tracks/bathyboat/CTD
HV17	11	40	18	.	.	X	-133.540017	68.776283	M	L3	2021-09-14T21:07:12.465	2021-09-14T21:11:41.445	get depth from GE tracks/bathyboat/CTD
HV18	12	50	19	.	.	X	-133.540067	68.776183	M	L3	2021-09-14T21:14:26.000	2021-09-14T21:16:12.000	get depth from GE tracks/bathyboat/CTD
HV19	13	60	20	.	.	X	-133.540417	68.776200	M	L3	2021-09-14T21:25:38.000	2021-09-14T21:27:02.000	get depth from GE tracks/bathyboat/CTD
HV20	14	70	21	.	.	X	-133.540700	68.776133	M	L3	2021-09-14T21:36:25.000	2021-09-14T21:38:10.000	get depth from GE tracks/bathyboat/CTD
HV21	15	80	22	.	.	X	-133.540783	68.776067	M	L3	2021-09-14T21:45:59.000	2021-09-14T21:49:20.115	get depth from GE tracks/bathyboat/CTD
HV22	16	90	23	.	.	X	-133.540933	68.776017	M	L3	2021-09-14T21:53:40.000	2021-09-14T21:57:55.915	get depth from GE tracks/bathyboat/CTD
HV23	17	100	24	.	.	X	-133.541083	68.775917	M	L3	2021-09-14T22:03:40.305	2021-09-14T22:07:59.505	get depth from GE tracks/bathyboat/CTD
HV24	18	110	25	.	.	X	-133.541117	68.775833	M	L3	2021-09-14T22:13:50.000	2021-09-14T22:16:50.155	get depth from GE tracks/bathyboat/CTD
HV25	S01	B13	1	14.8	4.51	X	-133.013100	69.457183	M	Tuk_NW_B1	2021-09-18T21:21:15.811	2021-09-18T21:25:21.061	depth from echo sounder
HV26	S02	B14/15	2	20	6.1	X	-133.012350	69.456383	M	Tuk_NW_B1	2021-09-18T21:36:41.000	2021-09-18T21:38:34.000	depth from echo sounder
HV27	S03	B21	3	0	0	1.69	-133.009733	69.454667	M	Tuk_NW_B1	2021-09-18T21:46:36.000	2021-09-18T21:51:04.811	on land
HV28	S04	X	4	0	0	1.5	-133.009717	69.454617	M	Tuk_NW_B1	2021-09-18T21:54:12.011	2021-09-18T21:58:46.451	on land
HV29	S05	B20	5	0	0	X	-133.009800	69.454700	M	Tuk_NW_B1	2021-09-18T22:05:55.391	2021-09-18T22:10:15.781	on land
HV30	S06	B19	6	0.66	0.2	X	-133.009933	69.454750	M	Tuk_NW_B1	2021-09-18T22:15:10.000	2021-09-18T22:15:44.000	direct depth
HV31	S07	B18	7	1.77	0.54	X	-133.010050	69.454867	M	Tuk_NW_B1	2021-09-18T22:21:50.000	2021-09-18T22:24:50.161	depth from echo sounder
HV32	S08	B17	8	1.84	0.56	X	-133.010250	69.454967	M	Tuk_NW_B1	2021-09-18T22:31:47.000	2021-09-18T22:35:20.421	depth from echo sounder
HV33	S09	B16	9	18	5.49	X	-133.011033	69.455583	M	Tuk_NW_B1	2021-09-18T22:50:00.321	2021-09-18T22:54:12.731	depth from echo sounder
HV34	S10	B15	10	19	5.79	X	-133.012700	69.456133	M	Tuk_NW_B1	2021-09-18T23:05:51.000	2021-09-18T23:09:34.401	depth from echo sounder
HV35	S11	B14	11	19	5.79	X	-133.012183	69.456583	M	Tuk_NW_B1	2021-09-18T23:17:07.000	2021-09-18T23:19:58.000	depth from echo sounder
HV36	Q01	X	12	0	0	1.42	-133.009017	69.454117	M	Tuk_SW_B1	2021-09-19T18:41:29.478	2021-09-19T18:46:08.988	on land
HV37	Q02	X	13	2.16	0.66	X	-133.008983	69.454083	M	Tuk_SW_B1	2021-09-19T18:49:26.848	2021-09-19T18:53:42.238	depth from echo sounder
HV38	Q03	X	14	2.82	0.86	X	-133.008933	69.454050	M	Tuk_SW_B1	2021-09-19T18:57:42.298	2021-09-19T19:02:15.878	depth from echo sounder
HV39	Q04	X	15	3.61	1.1	X	-133.008900	69.454017	M	Tuk_SW_B1	2021-09-19T19:06:48.548	2021-09-19T19:11:15.588	depth from echo sounder
HV40	Q05	X	16	4.33	1.32	X	-133.008850	69.454017	M	Tuk_SW_B1	2021-09-19T19:15:58.928	2021-09-19T19:20:16.868	depth from echo sounder
HV41	Q06	X	17	8.4	2.56	X	-133.008617	69.453883	M	Tuk_SW_B1	2021-09-19T19:33:02.188	2021-09-19T19:37:32.668	depth from echo sounder
HV42	Q07	X	18	8.2	2.50	X	-133.008217	69.453733	M	Tuk_SW_B1	2021-09-19T19:45:33.828	2021-09-19T19:50:10.498	depth from echo sounder
HV43	Q08	X	21	10	3.05	X	-133.007150	69.453567	M	Tuk_SW_B1	2021-09-19T19:57:38.618	2021-09-19T20:00:33.000	depth from echo sounder
HV44	Q09	X	23	10.3	3.14	X	-133.006633	69.453100	M	Tuk_SW_B1	2021-09-19T20:15:23.000	2021-09-19T20:16:56.000	depth from echo sounder
HV45	Q10	X	24	10.4	3.17	X	-133.006150	69.452767	M	Tuk_SW_B1	2021-09-19T20:32:26.978	2021-09-19T20:38:22.428	depth from echo sounder
HV46	Q11	X	26	11.3	3.44	X	-133.005933	69.452283	M	Tuk_SW_B1	2021-09-19T20:43:25.000	2021-09-19T20:49:04.000	depth from echo sounder
HV47	Q12B	X	27	12.8	3.90	X	-133.005467	69.451933	M	Tuk_SW_B1	2021-09-19T21:11:46.628	2021-09-19T21:16:46.718	depth from echo sounder
HV48	Q13	X	28	15.8	4.82	X	-133.004383	69.451483	M	Tuk_SW_B1	2021-09-19T21:24:56.708	2021-09-19T21:25:44.000	depth from echo sounder
HV49	Q14	X	29	0	0	1.39	-133.000917	69.455083	M	Tuk_SE_B2	2021-09-20T00:38:37.228	2021-09-20T00:43:03.608	on land
HV50	Q15	X	30	1.38	0.42	>1.5	-133.001033	69.455050	M	Tuk_SE_B2	2021-09-20T00:51:09.508	2021-09-20T00:55:47.528	direct depth
HV51	Q16	X	31	4.66	1.42	X	-133.000850	69.454983	M	Tuk_SE_B2	2021-09-20T01:02:20.558	2021-09-20T01:07:19.688	depth from echo sounder
HV52	Q17	X	32	3.51	1.07	X	-133.000850	69.454950	M	Tuk_SE_B2	2021-09-20T01:10:37.378	2021-09-20T01:15:19.758	depth from echo sounder
HV53	Q18B	X	33	7.8	2.34	X	-133.000450	69.454750	M	Tuk_SE_B2	2021-09-20T01:39:11.000	2021-09-20T01:43:30.988	depth from echo sounder
HV54	Q19	X	34	8.3	2.53	X	-132.999817	69.454533	M	Tuk_SE_B2	2021-09-20T01:51:40.728	2021-09-20T01:55:59.708	depth from echo sounder
HV55	Q20B	X	35	8.5	2.59	X	-132.999433	69.454250	M	Tuk_SE_B2	2021-09-20T02:02:48.148	2021-09-20T02:07:15.448	depth from echo sounder
HV56	Q21	X	36	11.2	3.41	X	-132.998700	69.454000	M	Tuk_SE_B2	2021-09-20T02:14:44.638	2021-09-20T02:19:00.198	depth from echo sounder
HV57	Q22	X	38	8	2.44	X	-132.998267	69.453783	M	Tuk_SE_B2	2021-09-20T02:24:48.118	2021-09-20T02:34:24.000	depth from echo sounder
HV58	Q23	X	39	4.7	1.43	X	-132.997933	69.453567	M	Tuk_SE_B2	2021-09-20T02:40:56.168	2021-09-20T02:43:47.000	depth from echo sounder
HV59	Q23B	X	40	5.5	1.68	X	-132.998050	69.453617	M	Tuk_SE_B2	2021-09-20T02:47:15.048	2021-09-20T02:51:29.508	depth from echo sounder
HV60	Q24	X	41	1.97	0.6	X	-132.997517	69.453367	M	Tuk_SE_B2	2021-09-20T02:59:57.558	2021-09-20T03:04:15.648	depth from echo sounder
HV61	Q25	X	42	2.62	0.8	X	-132.997667	69.453400	M	Tuk_SE_B2	2021-09-20T03:07:59.928	2021-09-20T03:12:04.088	depth from echo sounder
HV62	Q26	X	43	0	0	>1.5	-132.997383	69.453317	M	Tuk_SE_B2	2021-09-20T03:15:03.548	2021-09-20T03:19:08.728	on land
HV63	Q27	X	44	0	0	>1.5	-132.997133	69.453250	M	Tuk_SE_B2	2021-09-20T03:22:20.128	2021-09-20T03:26:38.288	on land
HV64	U01	B02	45	12.7	3.87	X	-133.008083	69.458067	M	Tuk_NE_B2	2021-09-20T16:01:43.188	2021-09-20T16:03:28.000	depth from echo sounder
HV65	U02	B03	46	11	3.35	X	-133.006083	69.457550	M	Tuk_NE_B2	2021-09-20T16:23:25.398	2021-09-20T16:27:55.448	depth from echo sounder
HV66	U03	B04	47	12.7	3.87	X	-133.005133	69.457167	M	Tuk_NE_B2	2021-09-20T16:37:25.000	2021-09-20T16:39:00.000	depth from echo sounder

HV67	U04	B05	48	6.9	2.10	X	-133.004617	69.456633	M	Tuk_NE_B2	2021-09-20T16:52:08.758	2021-09-20T16:56:22.398	depth from echo sounder
HV68	U05	B06	49	2.36	0.72	X	-133.003750	69.456417	M	Tuk_NE_B2	2021-09-20T17:02:22.458	2021-09-20T17:07:44.558	depth from echo sounder
HV69	U06	B07	50	3.12	0.95	X	-133.003567	69.456367	M	Tuk_NE_B2	2021-09-20T17:13:09.388	2021-09-20T17:17:30.398	depth from echo sounder
HV70	U07	B08	51	2.07	0.63	X	-133.003550	69.456250	M	Tuk_NE_B2	2021-09-20T17:22:29.668	2021-09-20T17:27:09.818	depth from echo sounder
HV71	U08	B09	52	2.00	0.61	X	-133.003450	69.456150	M	Tuk_NE_B2	2021-09-20T17:32:16.898	2021-09-20T17:36:24.948	depth from echo sounder
HV72	U09	B10	53	2.13	0.65	X	-133.003350	69.456117	M	Tuk_NE_B2	2021-09-20T17:40:10.768	2021-09-20T17:45:17.608	depth from echo sounder
HV73	U10	B11	54	1.60	0.49	X	-133.003233	69.456050	M	Tuk_NE_B2	2021-09-20T17:51:59.278	2021-09-20T17:56:23.698	depth from echo sounder
HV74	U11	X	55	0	0	1.44	-133.003067	69.455983	M	Tuk_NE_B2	2021-09-20T18:01:38.538	2021-09-20T18:06:03.608	on land
HV75	U12	X	56	0	0	1.25	-133.002983	69.455950	M	Tuk_NE_B2	2021-09-20T18:09:03.000	2021-09-20T18:13:02.378	on land
HV76	U13	X	57	0	0	0.84	-133.002967	69.455917	M	Tuk_NE_B2	2021-09-20T18:14:44.648	2021-09-20T18:19:42.528	on land
HV77	27	X01	62	0	1.09	X	-133.010800	69.455250	M	Tuk_NW_B1	2021-09-27T18:59:16.338	2021-09-27T19:03:30.398	depth from GE tracks
HV78	28	X02	63	0	6.14	X	-133.011033	69.456083	M	Tuk_NW_B1	2021-09-27T19:23:38.608	2021-09-27T19:27:48.898	depth from GE tracks
HV79	X03	X03	64	0	5.62	X	-133.012883	69.456850	M	Tuk_NW_B1	2021-09-27T19:35:51.228	2021-09-27T19:40:00.678	depth from GE tracks
HV80	29	X04	65	0	5.62	X	-133.013717	69.457650	M	Tuk_NW_B1	2021-09-27T19:47:53.488	2021-09-27T19:52:05.468	depth from GE tracks
HV81	30	X05	66	0	5.34	X	-133.014717	69.458383	M	Tuk_NW_B1	2021-09-27T20:00:03.218	2021-09-27T20:04:14.258	depth from GE tracks
HV82	31	X06	67	0	5.48	X	-133.015850	69.458600	M	Tuk_NW_B1	2021-09-27T20:12:55.198	2021-09-27T20:17:06.248	depth from GE tracks
HV83	32	X07	68	0	5.24	X	-133.016967	69.459267	M	Tuk_NW_B1	2021-09-27T20:31:54.578	2021-09-27T20:36:08.568	depth from GE tracks
HV84	33	Y01	69	0	2.32	X	-133.004133	69.456583	M	Tuk_NE_B2	2021-09-27T20:49:39.278	2021-09-27T20:53:27.788	depth from GE tracks
HV85	34	Y02	70	0	4.48	X	-133.005183	69.456950	M	Tuk_NE_B2	2021-09-27T21:08:47.178	2021-09-27T21:12:46.878	depth from GE tracks
HV86	37	0	71	.	.	X	-132.994100	69.455217	M	Tuk_South	2021-09-27T21:43:01.388	2021-09-27T21:47:05.788	get depth from GE tracks/CTD
HV87	38	60	72	.	.	X	-132.995500	69.455000	M	Tuk_South	2021-09-27T21:55:41.588	2021-09-27T21:59:58.438	get depth from GE tracks/CTD
HV88	39	120	73	.	.	X	-132.996783	69.454650	M	Tuk_South	2021-09-27T22:06:12.438	2021-09-27T22:10:16.328	get depth from GE tracks/CTD
HV89	40	185	74	.	.	X	-132.998317	69.454433	M	Tuk_South	2021-09-27T22:16:09.028	2021-09-27T22:20:22.838	get depth from GE tracks/CTD
HV90	41	250	75	.	.	X	-132.999900	69.454183	M	Tuk_South	2021-09-27T22:27:12.000	2021-09-27T22:29:26.258	get depth from GE tracks/CTD
HV91	42	360	76	.	.	X	-133.002767	69.454033	M	Tuk_South	2021-09-27T23:00:28.000	2021-09-27T23:03:40.258	get depth from GE tracks/CTD
HV92	43	420	77	.	.	X	-133.004133	69.453783	M	Tuk_South	2021-09-27T23:08:50.000	2021-09-27T23:10:41.000	get depth from GE tracks/CTD
HV93	46	Y03	82	14	4.27	X	-133.006083	69.456917	M	Tuk_NE_B2	2021-09-28T17:37:19.948	2021-09-28T17:41:12.848	depth from echo sounder
HV94	47	Y04	83	13	3.96	X	-133.007417	69.457750	M	Tuk_NE_B2	2021-09-28T17:49:09.000	2021-09-28T17:51:59.408	depth from echo sounder
HV95	48	Y05	84	12.9	3.93	X	-133.009783	69.458550	M	Tuk_NE_B2	2021-09-28T17:58:09.678	2021-09-28T17:58:30.000	depth from echo sounder
OBS1	24	OBS1	OBS1	.	.	X	-133.539700	68.776583	O	L3_OBS_A3S	2021-09-17T23:30:00.000	2021-09-22T19:39:00.000	get depth from GE tracks/bathyboat
OBS2	25	OBS2	OBS2	.	.	X	-133.540283	68.775917	O	L3_OBS_A3U	2021-09-18T00:20:00.000	2021-09-22T19:44:00.000	get depth from GE tracks/bathyboat
OBS3	OBS1	OBS1	OBS1	13.2	4.06	X	-133.015050	69.454800	O	Tuk_OBS_A46	2021-09-18T23:36:00.000	2021-09-20T18:33:00.000	depth from echo sounder
OBS4	OBS2	OBS2	OBS2	12.0	3.66	X	-133.003900	69.457717	O	Tuk_OBS_A3V	2021-09-18T23:48:00.000	2021-09-20T18:26:00.000	depth from echo sounder