

MOVE/AGAVE

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1. Description of the experiment

The project MOVE “Mid-Ocean Volcanoes and Earthquakes” of the AGAVE (Arctic Gakkel Vents Expedition) cruise on board the Swedish icebreaker ODEN aimed at recording microearthquakes at the ultraslow-spreading Gakkel Ridge in the Arctic ocean. The expedition focused on two survey sites where indications for hydrothermal venting were found previously: Site 1, near 8°E, in a magmatically starved area (Fig. 1) and Site 2 at a recently active volcanic complex near 85°E (Fig. 2). We spent about 5 days at the first site and 17 days at the second site. The survey areas were entirely covered with sea ice precluding the use of ocean bottom seismometers. We therefore used large multi-year icefloes as platforms for seismic stations and installed conventional land seismic stations in small aperture (1 km) seismological arrays as described below (Fig. 3). The equipment for one array could be transported in one helicopter flight to the icefloe. We installed three seismological arrays in each survey area. The distance between the arrays varied between 10 and 20 km (Figs. 1,2).

The ice drift carried the icefloes with the seismometers across the survey area (Figs. 1,2). As helicopter operations were limited to a distance of 20 nm from the ship due to safety reasons, the seismic stations had to be recovered before they left the operational range of the helicopter and redeployed up-drift. For site 2, this resulted in three array deployments (Fig. 2). Due to an ice coverage well over 90%, the icefloes all moved in unison but did not rotate, thus that the array and seismometer orientation towards geographical north remained unchanged even if the icedrift paths showed tidal cycles.

The arrays at the Site 1 were numbered 081, 082, 083. The individual seismic stations of array 081 are 0810 (central station), 0811 (north station), 0812 (SE station) and 0813 (SW station). The arrays at site 2 were numbered 851, 852 and 853. Due to several deployments, we added an extension for the deployment number (_1, _2, _3). The name convention of the individual stations applies correspondingly (Fig. 3 and Table 1).

2. Station instrumentation

Each seismological array consisted of four individual seismic stations. The stations are equipped with a Mark 4L3C short period three component seismometers. We used Reftek RT130 data logger with GPS receivers locking every 20 minutes GPS coordinates and time. The data logger were programmed to record continuously at a sampling rate of 100 Hz with a preamplification of 32. The data were written to industrial grade CF cards with 2 GB storage capacity provided by the Alfred Wegener Institute (AWI). The standard CF cards supplied by IRIS/PASSCAL failed operational test in the cold chamber at -20°C at the AWI.

An absorbed-glass-mat rechargeable battery with a capacity of 80 Ah served as power source. The central array stations were additionally equipped with a Xeos technology ARGOS transmitter which transmits the state-of-health of the data logger and which can be tracked allowing to monitor the position of the seismometer ice floes. The ARGOS transmitter had an indepen-

dent power source (AGM battery) to ensure its functionality for save retrieval of the instruments.

The seismometers stem from the geophysical instrument pool of the Geoforschungszentrum Potsdam. 4 data logger (marked in Fig. 3 and Table 1) and the ARGOS transmitter were borrowed from the IRIS/PASSCAL instrument pool. The remaining equipment is owned by the AWI.

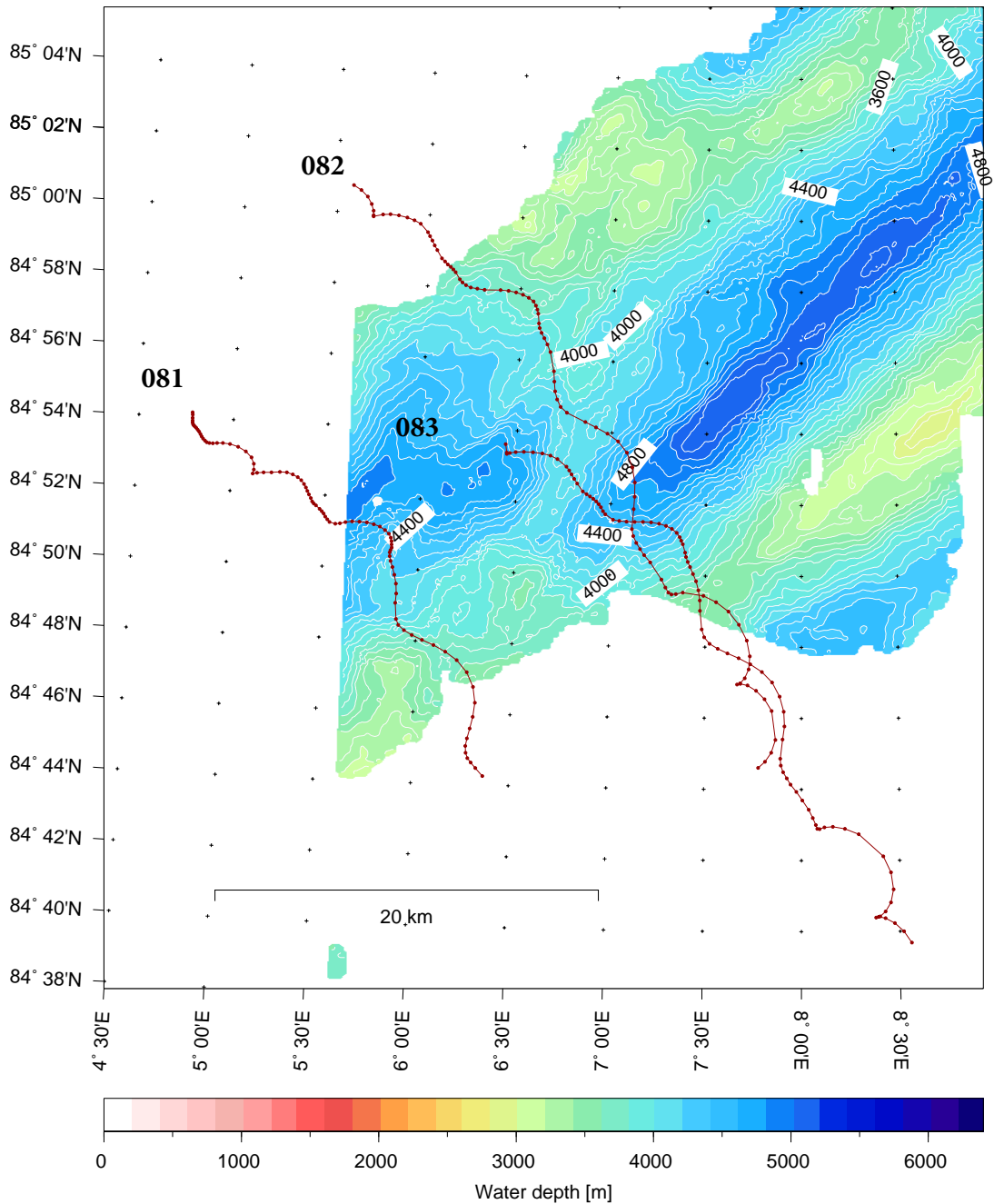


Figure 1: Drift paths of the seismic arrays at Site 1. The drift of the central array stations is shown. Dots represent hourly GPS positions. The deployment sites are marked with the array numbers.

3. Station setup

We selected multi-year icefloes of at least 1 km size as array platforms. Slightly elevated places with good snow cover away from major pressure ridges were suitable seismometer sites. Soft snow was removed from the icefloe and the icy ground was levelled. A wooden plate served as seismometer platform. The seismometer was then levelled, a bucket put over it and covered with an about 1 m high snow heap. Less snow would melt and leave the seismometer unshel-

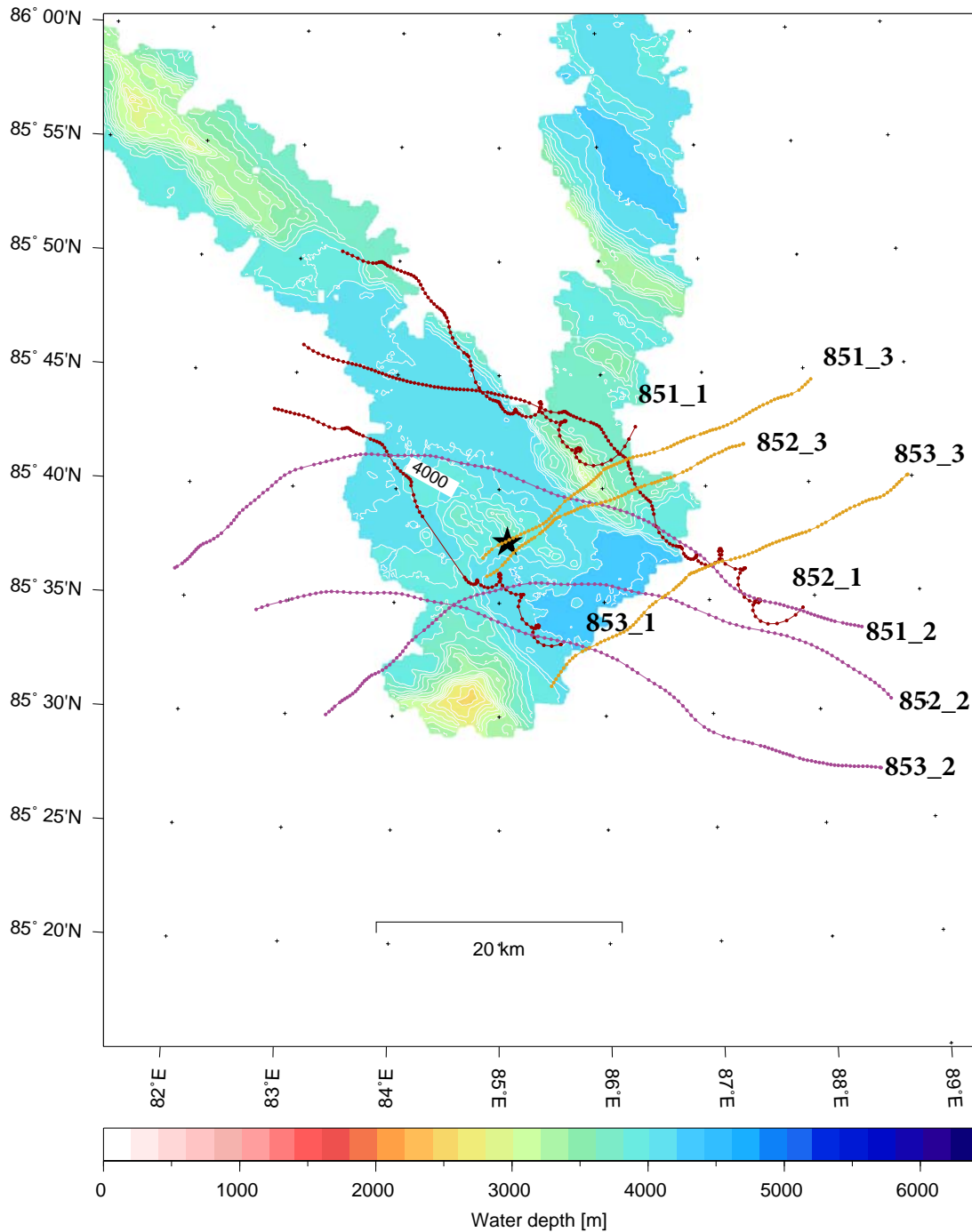


Figure 2: Drift paths of the seismological arrays at Site 2. The star marks the ship position. Hourly GPS positions of the central array station are shown. The deployment sites are labeled with the array names, the last figure (_1,2,3) refers to the first, second and third deployment of array 851,852 and 853, respectively.

tered. The data logger, battery and ARGOS transmitter were housed in an insulated red box with the GPS antenna strapped to its lid. A flag was mounted at a distance of at least 10 m to mark the seismic station but to avoid coupling of wind induced motion into the ice.

4. Recording times

Table 1 gives an overview over station deployment and recovery sites and times with continuous data recording in between.

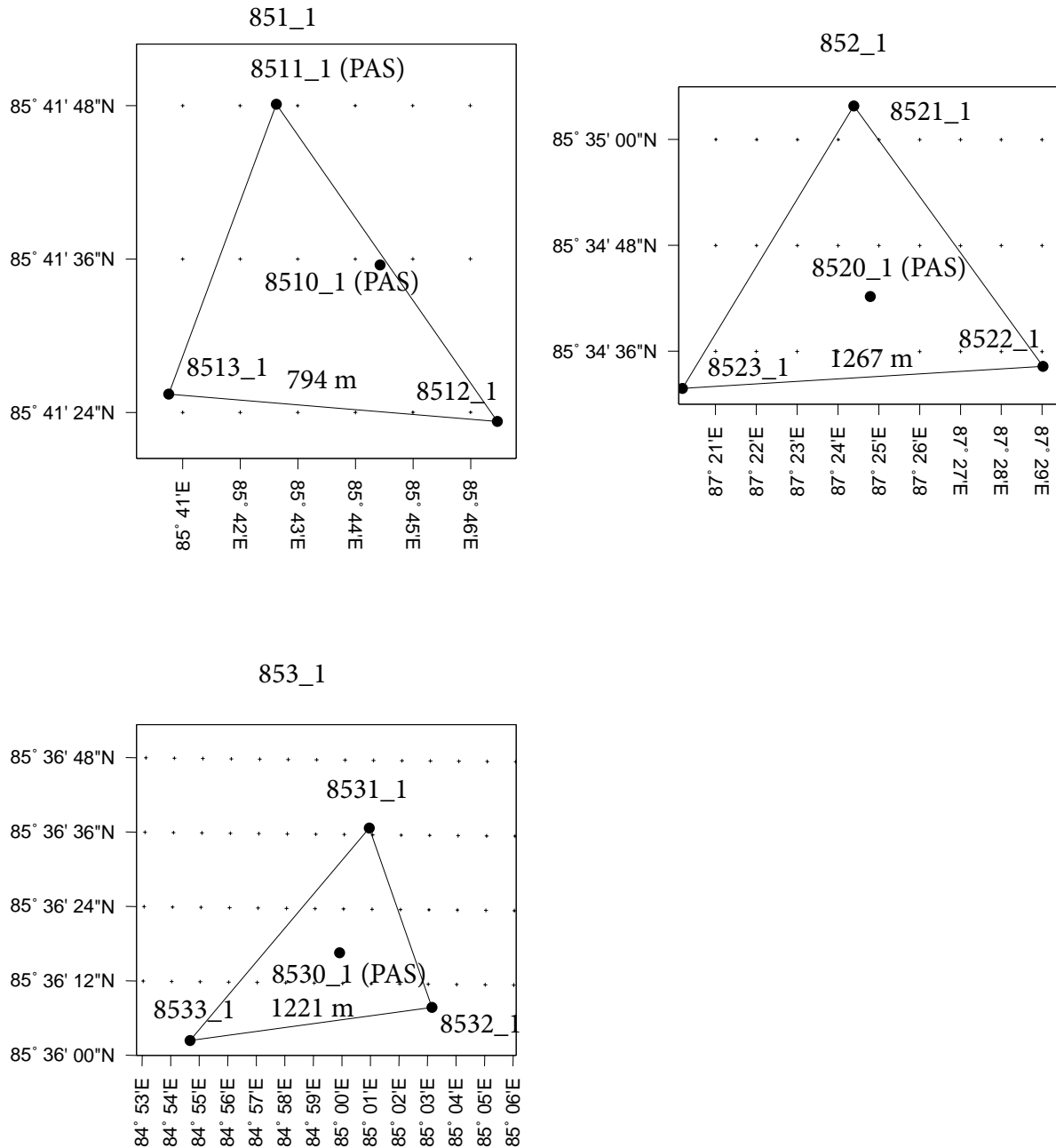


Figure 3: Examples of array geometries. Dots mark the seismic station positions. Each array is situated on one icefloe. The central station is equipped with an ARGOS transmitter. The approximate length of the baseline is given in meters. PASSCAL instruments are labeled PAS.

5. Station recovery

We received every day about 4-7 ARGOS positions with a quality flag of 2 or 3, equivalent to a location error of 350m or less. We used the latest ARGOS position as way point for the recovery search and continued from there in direction of the icedrift as provided by ice buoy recordings of ODEN. Thus, we were able to find the seismometer ice floes even in poor visibility. The red color of the boxes and the flags helped to spot the individual seismic stations on the icefloe. All equipment was safely recovered by helicopter. We experienced no instrument failure or damage to equipment.

6. Data analysis

We downloaded the data from the CF cards to a linux laptop and converted the data to segy format. The data at the first site were recorded in "32-format". Due to data conversion problems with our field linux laptop, the remaining data were recorded in compressed format which could be converted in the field without problems. The data from the first site have been converted successfully on our UNIX computers at AWI.

Data analysis in the field was limited to a superficial screening for events and a quality check. Local, regional and teleseismic events could be identified in the data set, but no events of special nature.

7. Data DVD

The attached DVD includes the data from all PASSCAL data logger. The data at the first site (directories raw081, raw082, raw083) were recorded in "32-format", the remaining data were recorded in compressed format. Data stream 1 was used and includes channels 1,2,3 corresponding to Z, N, E, respectively.

Table 1: Station list

Reftex SN	Station		Date	Time (UTC)	GPS Lat	GPS Long
991C (Passcal)	0810	Deployment	05.07.2007	13:15	84° 54.23'	4° 46.79'
		Recovery	09.07.2007	13:55	84° 44.07'	6° 23.77'
	8510_1	Deployment	15.07.2007	11:40	85° 43.03'	86° 22.81'
		Recovery	20.07.2007	12:54	85° 50.42'	83° .23.12'
	8510_2	Deployment	21.07.2007	09:45	85° 33.49'	88° 26.86'
		Recovery	27.07.2007	08:50	85° 36.11'	81° 53.06'
	8510_3	Deployment	27.07.2007	09:50	85° 44.51'	88° 04.55'
		Recovery	31.07.2007	14:50	85° 36.85'	84° 49.34'
9869 (Passcal)	0811	Deployment	05.07.2007	13:52	84° 54.40'	4° 46.46'
		Recovery	09.07.2007	14:15	84° 44.19'	6° 24.41'
	8511_1	Deployment	15.07.2007	12:14	85° 43.13'	86° 20.24'
		Recovery	20.07.2007	12:40	85° 50.62'	83° 22.03'
	8511_2	Deployment	21.07.2007	10:00	85° 33.91'	88° 26.00'
		Recovery	27.07.2007	09:00	85° 36.51'	81° 52.09'

Table 1: Station list

Refttek SN	Station		Date	Time (UTC)	GPS Lat	GPS Long
	8511_3	Deployment	27.07.2007	10:35	85° 44.67'	88° 03.35'
		Recovery	31.07.2007	15:00	85° 37.07'	84° 49.05'
9179 (AWI)	0812	Deployment	05.07.2007	14:15	84° 53.97'	4° 49.47'
		Recovery	09.07.2007	14:30	84° 43.69'	6° 27.97'
	8512_1	Deployment	15.07.2007	12:43	85° 42.58'	86° 22.71'
		Recovery	20.07.2007	12:20	85° 50.17'	83° 26.60'
	8512_2	Deployment	21.07.2007	10:30	85° 33.49'	88° 27.59'
		Recovery	27.07.2007	08:20	85° 36.15'	81° 55.90'
	8512_3	Deployment	27.07.2007	10:50	85° 44.27'	88° 05.15'
		Recovery	31.07.2007	14:30	85° 36.80'	84° 52.22'
9170 (AWI)	0813	Deployment	05.07.2007	14:55	84° 53.91'	4° 45.29'
		Recovery	09.05.2005	13:35	84° 43.96'	6° 21.43'
	8513_1	Deployment	15.07.2007	13:26	85° 42.49'	86° 15.96'
		Recovery	20.07.2007	13:10	85° 50.27'	83° 18.40'
	8513_2	Deployment	21.07.2007	10:40	85° 33.38'	88° 23.15'
		Recovery	27.07.2007	08:30	85° 35.98'	81° 51.98'
	8513_3	Deployment	27.07.2007	11:15	85° 44.18'	88° 00.43'
		Recovery	31.07.2007	14:40	85° 36.72'	84° 47.87'
988E (Pascal)	0820	Deployment	06.07.2007	10:10	85° 00.82'	5° 32.84'
		Recovery	10.07.2007	18:50	84° 44.55'	7° 45.27'
	8520_1	Deployment	15.07.2007	15:04	85° 34.90'	87° 56.55'
		Recovery	22.07.2007	20:00	85° 46.41'	83° 00.94'
	8520_2	Deployment	22.07.2007	21:00	85° 30.24'	88° 40.34'
		Recovery	27.07.2007	15:00	85° 29.92'	83° 21.27'
	8520_3	Deployment	27.07.2007	15:55	85° 41.79'	87° 23.39'
		Recovery	30.07.2007	23:00	85° 36.17'	84° 52.82'
9171 (AWI)	0821	Deployment	06.07.2007	11:50	85° 00.99'	5° 34.39'
		Recovery	10.07.2007	19:00	84° 44.77'	7° 44.74'
	8521_1	Deployment	15.07.2007	16:30	85° 35.11'	87° 55.36'
		Recovery	22.07.2007	19:45	85° 46.71'	83° 01.22'
	8521_2	Deployment	22.07.2007	21:50	85° 30.61'	88° 38.32'
		Recovery	27.07.2007	14:30	85° 30.14'	83° 21.27'

Table 1: Station list

Refttek SN	Station		Date	Time (UTC)	GPS Lat	GPS Long
	8521_3	Deployment	27.07.2007	17:05	85° 41.93'	87° 21.10'
		Recovery	30.07.2007	22:40	85° 36.41'	84° 54.14'
9173 (AWI)	0822	Deployment	06.07.2007	11:30	85° 00.65'	5° 37.81'
		Recovery	10.07.2007	19:20	84° 44.46'	7° 46.44'
	8522_1	Deployment	15.07.2007	15:45	85° 34.47'	87° 58.45'
		Recovery	22.07.2007	19:25	85° 46.19'	83° 06.97'
	8522_2	Deployment	22.07.2007	22:35	85° 30.54'	88° 38.68'
		Recovery	27.07.2007	14:25	85° 29.94'	83° 24.14'
	8522_3	Deployment	27.07.2007	17:15	85° 41.57'	87° 20.29'
		Recovery	30.07.2007	23:00	85° 36.04'	84° 53.45'
9172 (AWI)	0823	Deployment	06.07.2007	12:00	85° 00.53'	5° 35.59'
		Recovery	10.07.2007	19:30	84° 44.45'	7° 42.28'
	8523_1	Deployment	15.07.2007	16:10	85° 34.34'	87° 48.29'
		Recovery	22.07.2007	20:15	85° 46.27'	82° 55.65'
	8523_2	Deployment	22.07.2007	21:30	85° 30.23'	88° 35.73'
		Recovery	27.07.2007	15:10	85° 29.75'	83° 17.16'
	8523_3	Deployment	27.07.2007	16:10	85° 41.66'	87° 20.10'
		Recovery	30.07.2007	23:20	85° 36.05'	84° 49.99'
9483 (Passcal)	0830	Deployment	06.07.2007	14:45	84° 53.65'	6° 26.31'
		Recovery	10.07.2007	13:35	84° 39.63'	8° 33.77'
	8530_1	Deployment	15.07.2007	19:09	85° 33.19'	85° 35.99'
		Recovery	20.07.2007	20:30	85° 43.39'	82° 46.65'
	8530_2	Deployment	20.07.2007	21:30	85° 27.26'	88° 32.09'
		Recovery	25.07.2007	21:20	85° 34.46'	82.40.49'
	8530_3	Deployment	27.07.2007	06:30	85° 40.06'	88° 57.94'
		Recovery	31.07.2007	20:55	85° 31.20'	85° 28.60'
9174 (AWI)	0831	Deployment	06.07.2007	14:58	84° 53.81'	6° 26.88'
		Recovery	10.07.2007	14:45	84° 39.24'	8° 35.02'
	8531_1	Deployment	15.07.2007	19:29	85° 33.48'	85° 34.63'
		Recovery	20.07.2007	20:06	85° 43.71'	82° 48.69'
	8531_2	Deployment	20.07.2007	22:00	85° 27.60'	88° 31.42'
		Recovery	26.07.2007	21:40	85° 34.76'	82° 39.68'

Table 1: Station list

Refttek SN	Station		Date	Time (UTC)	GPS Lat	GPS Long
	8531_3	Deployment	27.07.2007	06:50	85° 40.25'	88° 57.50'
		Recovery	31.07.2007	21:15	85° 31.37'	85° 28.38'
9175 (AWI)	0832	Deployment	06.07.2007	15:20	84° 53.29'	6° 30.24'
		Recovery	10.07.2007	14:20	84° 38.99'	8° 38.23'
	8532_1	Deployment	15.07.2007	19:45	85° 32.96'	85° 34.74'
		Recovery	20.07.2007	20:14	85° 43.26'	82° 50.54'
	8532_2	Deployment	20.07.2007	22:40	85° 26.99'	88° 32.81'
		Recovery	26.07.2007	21:00	85° 43.24'	82° 45.22'
	8532_3	Deployment	27.07.2007	07:10	85° 39.90'	88° 58.73'
		Recovery	31.07.2007	20:30	85° 31.17'	85° 30.82'
9169 (AWI)	0833	Deployment	06.07.2007	15:58	84° 53.24'	6° 23.09'
		Recovery	10.07.2007	13:50	84° 39.18'	8° 31.11'
	8533_1	Deployment	15.07.2007	20:30	85° 32.88'	85° 23.25'
		Recovery	20.07.2007	20:47	85° 43.14'	82° 40.67'
	8533_2	Deployment	20.07.2007	22:25	85° 27.03'	88° 25.46'
		Recovery	26.07.2007	21:10	85° 34.20'	82° 36.14'
	8533_3	Deployment	27.07.2007	07:30	85° 39.89'	88° 54.56'
		Recovery	31.07.2007	20:40	85° 31.15'	85° 26.99'