

# Summary of geological field data from the Thule Black Sand Province collected in 2015

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GEOLOGICAL SURVEY OF DENMARK AND GREENLAND  
DANISH MINISTRY OF CLIMATE, ENERGY AND BUILDING



**GEUS**

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# 1. Overview

Title: Thule Black Sands: Summary of geological sampling activities, 2015.

Between 11th August and 27th August 2015, GEUS conducted a combined geological / geophysical survey of the ilmenite / heavy mineral sand placer deposits close to Moriussaq, Thule District, NW Greenland, on behalf of Blue Jay Mining. The field team comprised

- Jørn Bo Jensen, Senior Geologist, GEUS, expedition leader, scientist in charge of geophysical survey
- Samuel Weatherley, Postdoctoral Research Scientist, GEUS, scientist in charge of geological survey
- Lars Georg Rödel, Hydrographic Surveyor, GEUS
- Mike Hodgkinson, Field Technician, Blue Jay Mining
- Jason Dalziell, Field Technician, Blue Jay Mining.

The field program was conducted using a ship as a base. From 11th August - 14th August, our ship was Kisaq (owned by Anders Pedersen, Nuuk) and from the 14th August until the end of the field season our ship was Duda Lasø (owned by Lasø Upernavik ApS).

This report constitutes a summary of geological field activities in the area shown in figure 1. It accompanies GEUS Report 2015/74, which provides results from an offshore boomer seismic and bathymetry survey that was conducted at the same time. Appendix A provides a complete list of samples taken during the field period and a qualitative visual guesstimate of the heavy mineral content of the sediment.

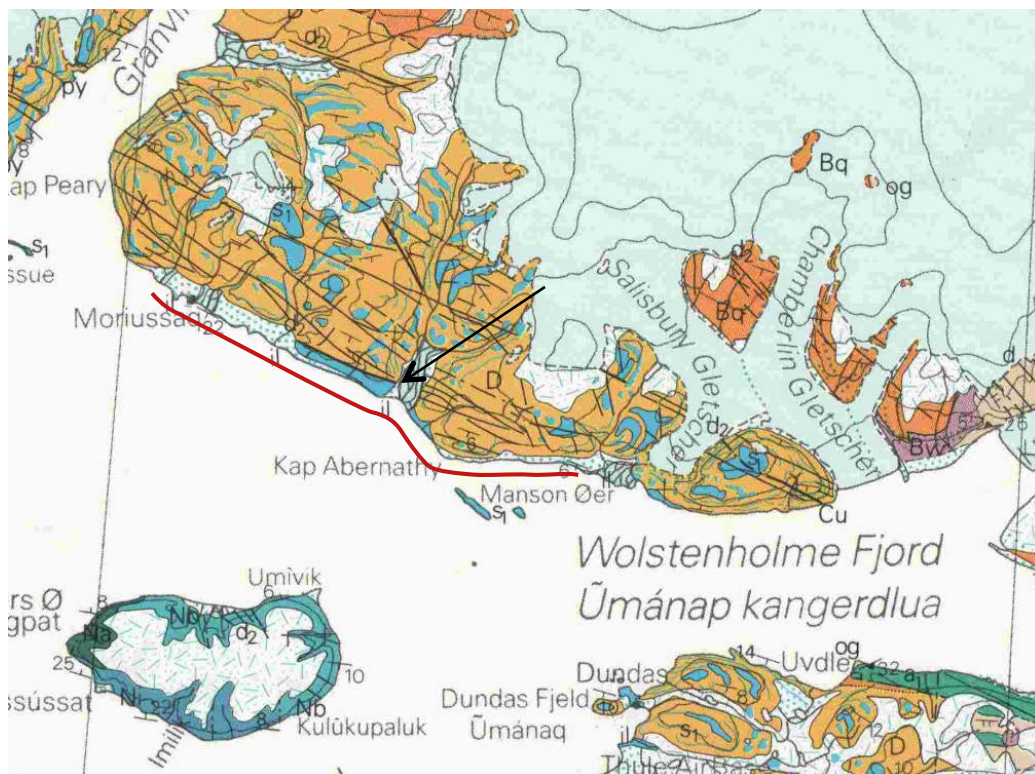


Figure 1. Geological map of the field area. Red line shows the stretch of coast sampled during the field work. Black arrow indicates the position of Iterlak. Map taken from Dawes (1991).

## 2. Useful Contacts

Kim Petersen, Entrepreneur, Qaanaaq. [qnqentrepreneur@greennet.gl](mailto:qnqentrepreneur@greennet.gl), tel: +299 59 46 55.

Petrine Hansen, Accommodation in Qaanaaq, tel: +299 49 93 58.

Meteorologist (24 hr weather service) tel: +299 84 10 22

DMI Weather station in Qaanaaq (manned year-round).

### **3. Sampling Methodology**

The sampling program consisted of an onshore component and an offshore component that are dealt with separately below. It is also important to note that the weather and sea conditions remained constant throughout the duration of the sampling program, enabling the deposits to be sampled under near-constant external environment conditions.

#### **3.1 Onshore Sampling**

Rather than sampling using a grid system, the sampling program adapted and responded to local changes in the geological and depositional environment, ensuring that all variations in the prospect area were recorded with samples and notes. Traverses were typically made along active beaches (including the intertidal and back beach zones) and raised terraces (where traverses extend inland up through the terrace sequence). To collect the samples, holes were dug using a metal shovel, geological information was then recorded (e.g. structure, lithology, sorting, colour, local variations, size of hole), and material was then sampled over a recorded depth using a large plastic scoop. The samples were then examined using a hand lens for mineralogy, grain size and changes between sample locations. Where possible (most samples) a visual estimate of the metallic fraction was made. With the exception of a few localities, the material was not subjected to magnetic separation. In general, magnetic separation was not possible because the moisture and / or water content of the sample induced cohesion between the different grains. Anomalously large pebbles and cobbles were removed from the samples, which were then transferred from the scoop into calico, clear plastic, or woven plastic bags depending on their size and wetness. For most localities, a close-up photo of the sample was also taken on a white, laminated sheet. Every sample was assigned a sample number of the form 15BJMXXXX, the GPS location was recorded, and photos of the sample spot were taken. At the end of day, samples were checked in to ensure all of the correct information was correctly recorded.

Between samples, all of the equipment was either washed or brushed free from sand grains, and its cleanliness was checked. At the sample locations, possible contamination was avoided by sampling an untrodden, pristine area that had not been interfered with by members of the field crew, and an area that was free from transient traps, such as seaweed, or where there had been recent wildlife activity.

#### **3.2 Offshore Sampling**

The approach to sampling offshore was two fold. First, samples were collected from locations as close as possible to seismic shot points, enabling direct comparison between geophysical signals and geological material. Secondly, in areas of special interest, additional samples were taken around side of a shot point, in a direction either parallel to the shore or perpendicular to it. Samples were taken from a small fibreglass boat (large enough for 4 people plus equipment) using a c. 8 litre stainless steel, rust-free Van Veen grab attached to a rope marked in 1 metre increments.

Sample locations were approached by sailing the boat to a point upstream of the sample

location at a slow speed, setting the engine to idle, and then drifting with the current to the point of interest. When the boat was above the point of interest, the grab was lowered to the sea floor, the gps position recorded, and the water depth estimated by mean of the graticules on the rope. At the start of the offshore sampling program, several tests were made to understand whether it was better to lower the grab gently to the seafloor, or whether to allow it to free-fall. Although the second method has the disadvantage that a pressure wave can build up in front of the descending grab and disturb the topmost layer of the seafloor sediment, we adopted that as the favoured method since it gave more consistent and markedly better sample recovery. Most seafloor samples contained some clay fraction, which helps bind the sand grains together and minimizes disturbance related to the pressure wave.

At each locality, the grab was raised by hand from the seafloor. The grab was checked to ensure that the jaws were completely closed, and the inspection hatches on top of the grab were opened to determine whether the grab was full of water. If both of these criteria were met, the chances for material loss between the seafloor and surface were deemed minimal, and the sample was accepted into a clean bucket. If not, the sample was rejected into an area away from the next target location. Whilst the sample was still in the bucket it was observed for geological information (e.g. colour, grain size, type of material, structure, smell). If the amount of excess water precluded observation of the sample, excess water was carefully drained out of the bucket, ensuring that no grains were lost, until the sample was exposed more clearly. After the observations had been recorded, any shelly organisms or fish were removed from the sample, and the sample was then transferred via a large plastic scoop to a labeled and colourless plastic sample bag. A small amount of clean seawater was introduced to the bucket and agitated to loosen any remaining sediment, and then this water and all remaining sediment within the bucket was transferred to the sample bag. Next, a constriction was made in the neck of the bag, and any excess water was drained into the sea, paying close attention that no grains were lost, and the bag was tied. Finally, all equipment was checked whether it was free from grains (if not, these were transferred to the sample bag), rinsed and checked again to ensure it was free from possible contaminating grains.



**Figure 2** The Van Veen grab used for collecting offshore samples.

### **3.3 Pan Concentrates**

Several panning concentrates were made from a selection of samples. The purpose of this was either to check for the presence of metallic grains, or to produce a concentrate for analysis. Panning was done on board the support / accommodation boat Duda Lasø. To obtain material for panning, a 75-150 ml subsample was taken from a previously collected sample using a small plastic scoop. The subsample was introduced to a clean plastic pan and processed with seawater. When the purpose of the panning exercise was to produce a concentrate, the metallic-rich residue was transferred to a clean, labelled, 100 ml HDPE sample beaker with a screw-on lid, using extra seawater if necessary. The beaker was then left to stand and most of the excess water was carefully drained off once all suspended material had settled out. At all stages sample labels were carefully handled and checked to avoid any inconsistencies in numbering. The equipment was then checked for remaining grains, thoroughly washed and checked again to ensure it was free from potential contaminants.

### **3.4 Location of data points**

All sample positions were recorded in WGS 1984 UTM Zone 19N using a handheld gps unit. Position and sample information was recorded in a spreadsheet at the end of each working day. At each sample site, the date, UTM position and sample number was written onto a whiteboard and then photographed. Additional photographs of the surroundings were taken in the N, E, S and W directions. Additional photos were taken at the geologists discretion.

### **3.5 Sample Security**

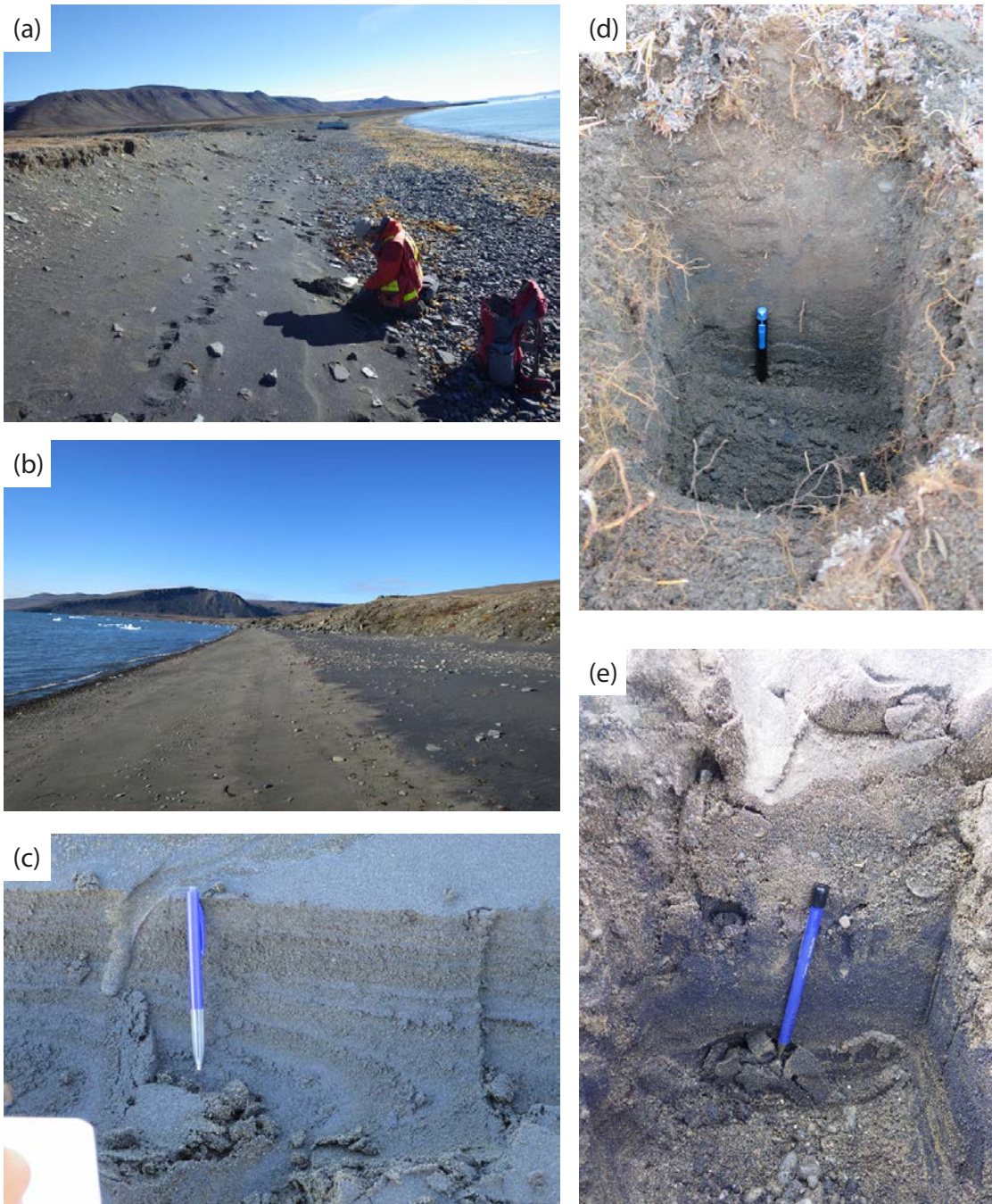
All samples were stored securely on board the ship at the end of each working day. At the end of the field season the samples were transferred to a shipping container that was then securely padlocked and sealed with a customs seal.



## 4. Key results

- A total of 251 samples were collected from the combined on- and off-shore regions, with the majority of samples taken onshore. A map of the sample locations is presented in Appendix A.
- On the active beaches, the highest grades are observed around Moriusaq Bay, and the beaches flanking Iterlak (figure 2a, 2b).
- Pits were dug on the raised terraces to a depth of approximately 60 cm. Many of these pits exhibited layers of sediment 5-10 cm thick that were extremely rich in metallic grains (figure 2d).
- Layers of near-pure metallic sand were also found in trenches dug into the ankle foreland at Iterlak (figure 2e).

Detailed results for each locality are presented in Appendix B.



**Figure 3** Field photos taken from some of the active beaches and raised terraces between Moriusaq and Kap Abernathy. (a) The active beach at Moriusaq, view E. The beach here contains a high volume fraction of ilmenite. (b) The active beach between Iterlak and Kap Abernathy. Note the ilmenite-rich sand at the back of the active beach. (c) A 20 cm vertical profile cut through the active beach at 15BJM056 showing ilmenite-rich layers. (d) 50 cm deep pit dug through a raised terrace, showing a high fraction of metallic sand towards the base of the pit. (e) A 10 cm thick layer of metallic sand in a trench dug into the ankle foreland at Iterlak.

## 5. References

Dawes, P. (1991) Geological Map of Greenland Sheet 5 Thule, 1:500 000.

## 6. Appendix

Pitufik Titanium Project  
Field Work 2016

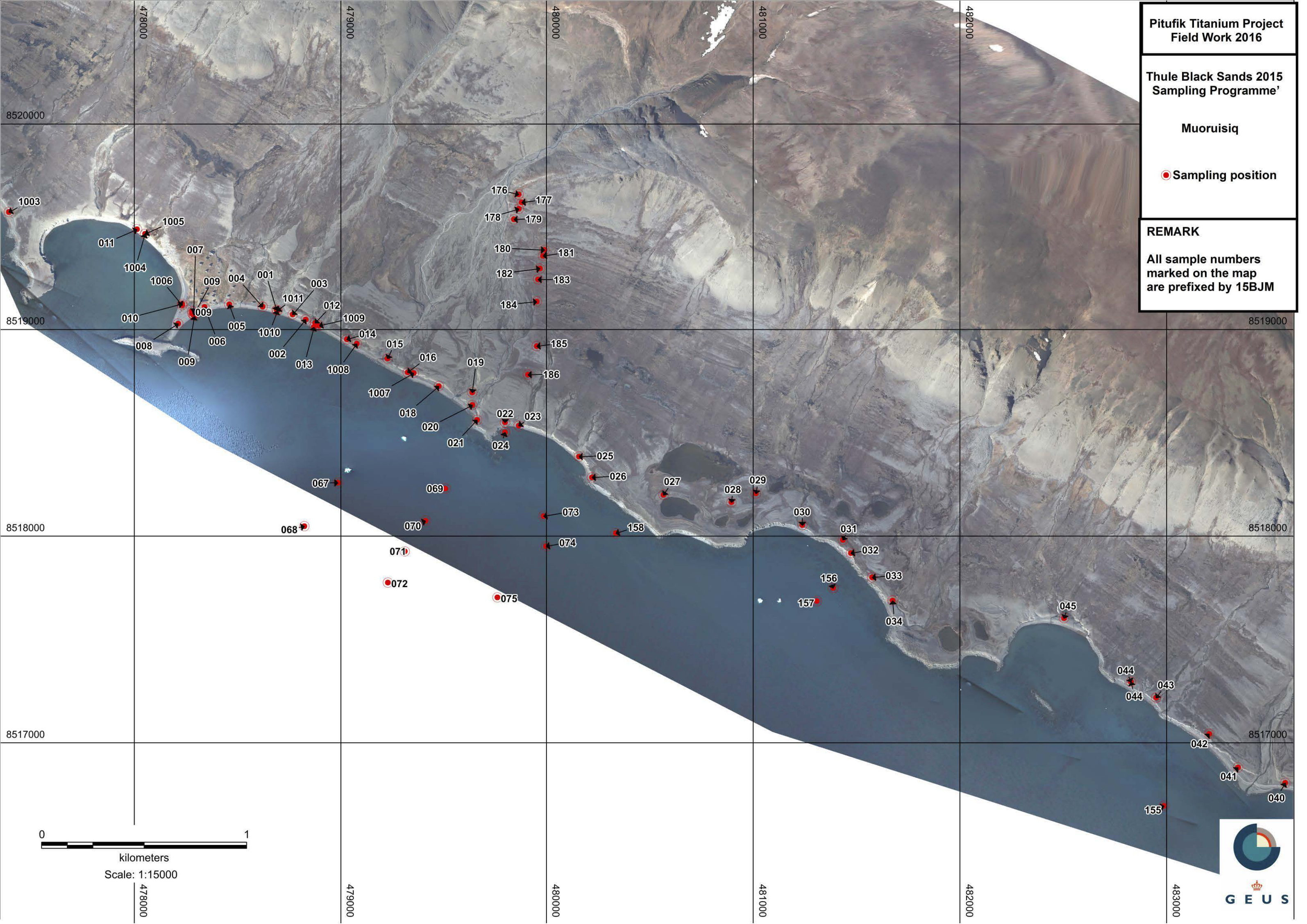
Thule Black Sands 2015  
Sampling Programme'

Muoruisiq

● Sampling position

REMARK

All sample numbers  
marked on the map  
are prefixed by 15BJM



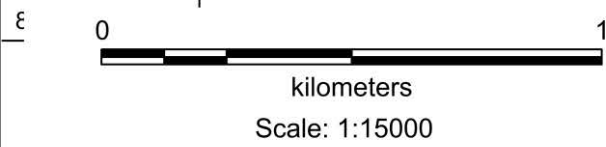
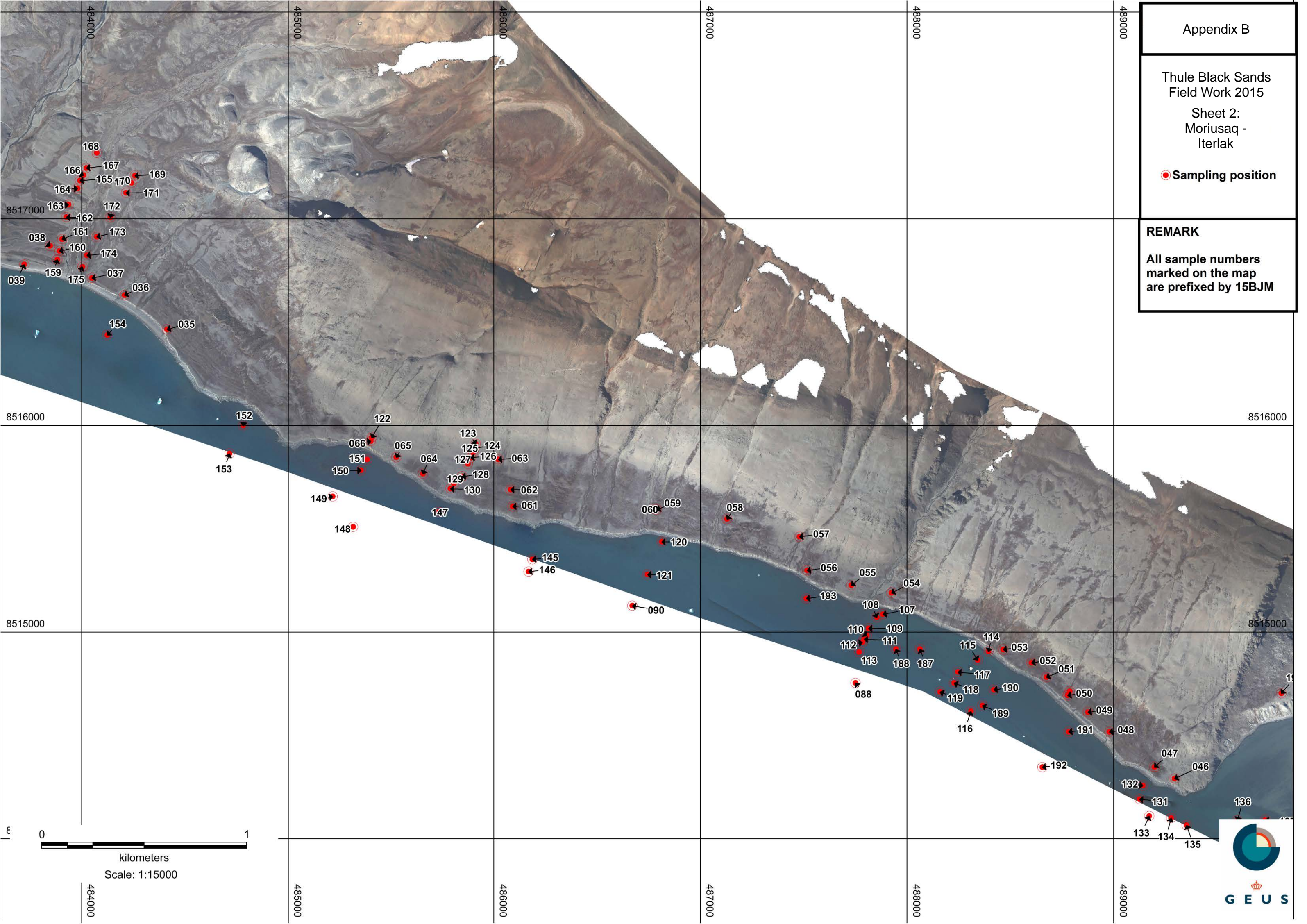
kilometers  
Scale: 1:15000



● Sampling position

**REMARK**

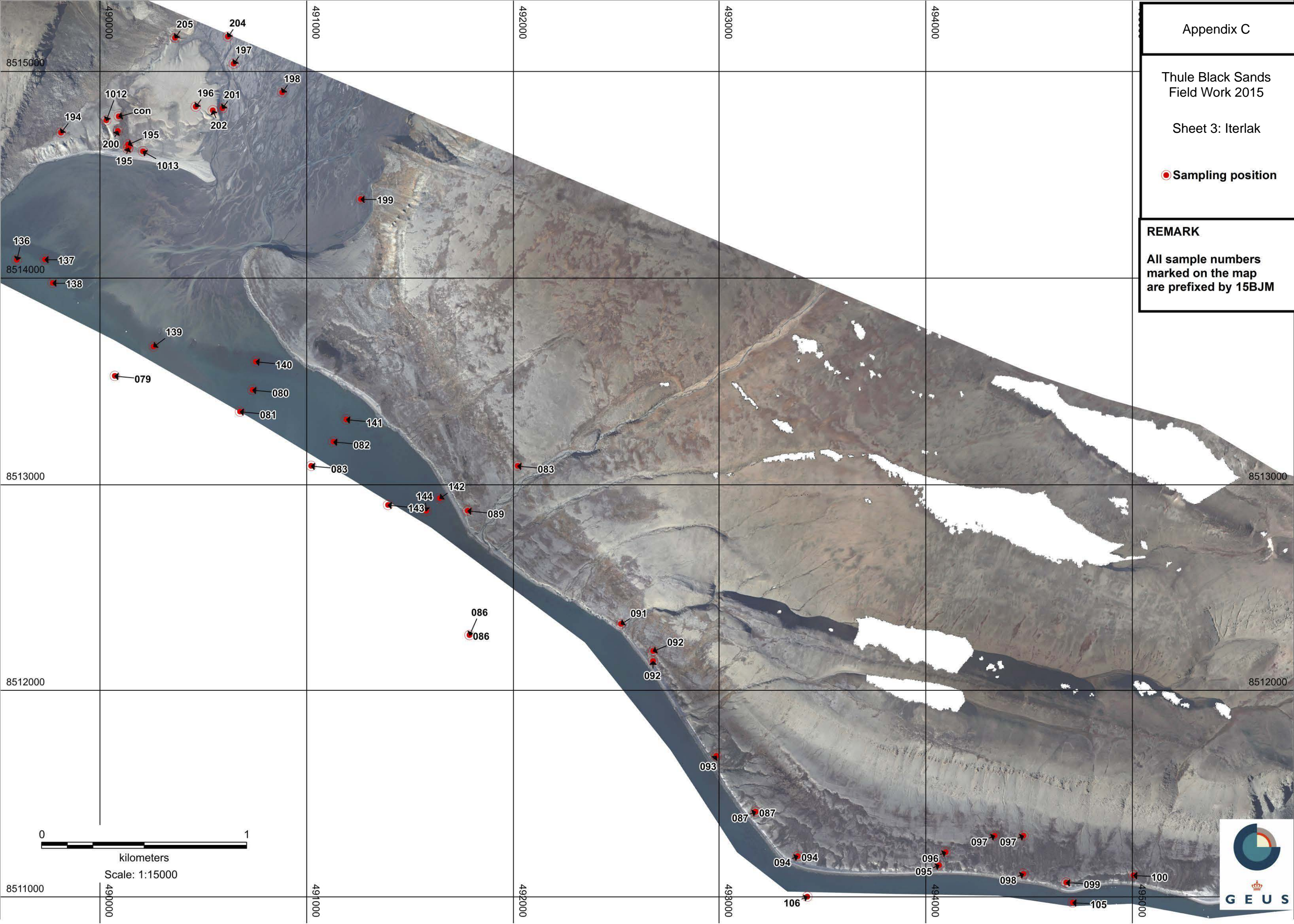
All sample numbers  
marked on the map  
are prefixed by 15BJM



● Sampling position

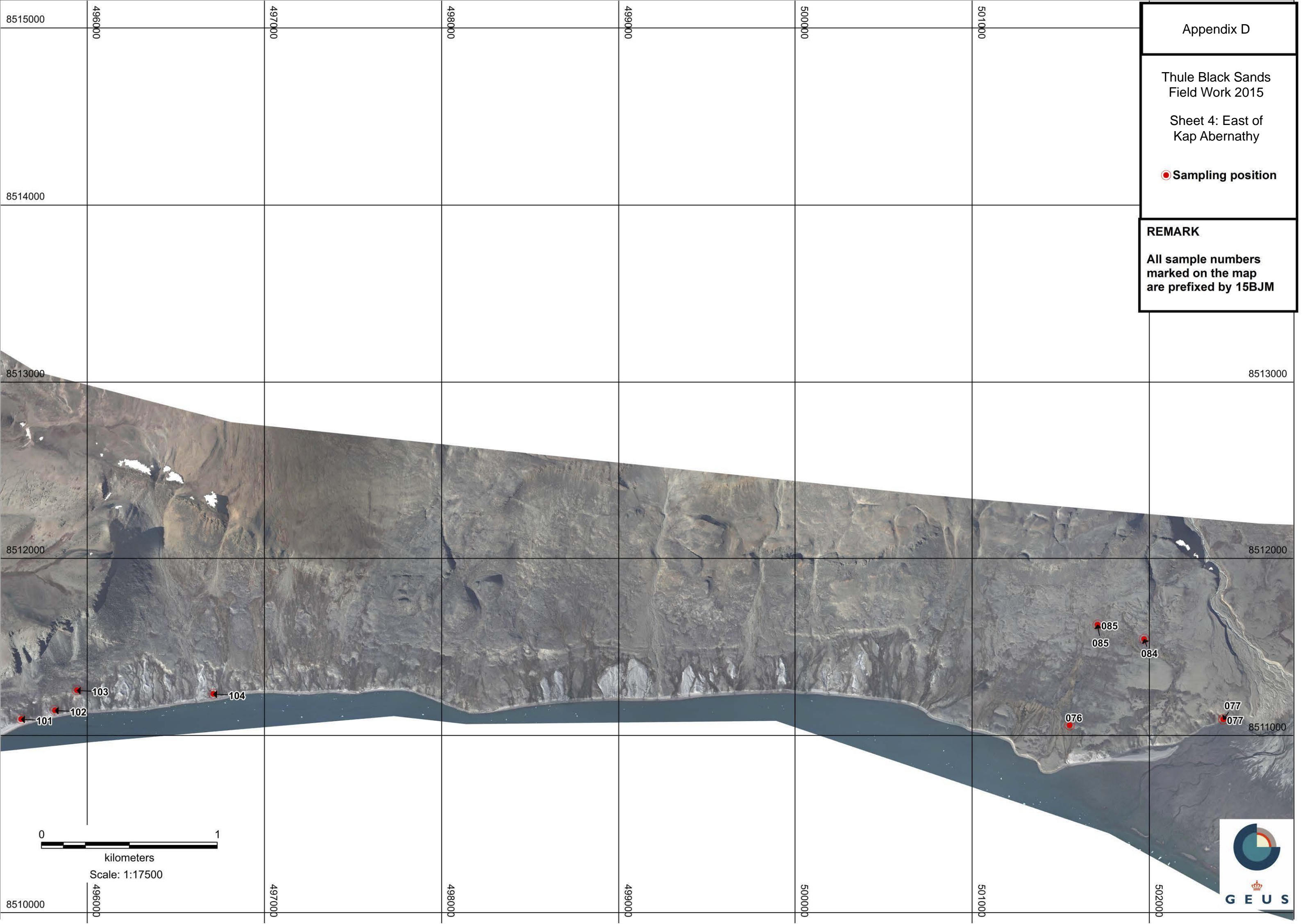
REMARK

All sample numbers  
marked on the map  
are prefixed by 15BJM



kilometers  
Scale: 1:15000





Appendix D

Thule Black Sands  
Field Work 2015

Sheet 4: East of  
Kap Abernathy

● Sampling position

**REMARK**

All sample numbers  
marked on the map  
are prefixed by 15BJM



kilometers  
Scale: 1:17500





Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
06/08/15	BJM_1000	453988	8537507	none	1	30	<2			
06/08/15	BJM_1001	478242	8532230	none	1	30	<2			
06/08/15	BJM_1002	476953	8531094	none	1	30	<2	2 samples 2nd taken from 476886 8530872		
07/08/15	BJM_1003	477395	8519571	none	1	30	<2	sea shore		
07/08/15	BJM_1004	478054	8519465	none	1	30	<2	sea shore 2 samples in one spot		
07/08/15	BJM_1005	478054	8519465	none	1	30	<2	sea shore 2 samples in one spot		
07/08/15	BJM_1006	478234	8519119	none	1	30	<2	sea shore		
07/08/15	BJM_1007	479355	8518791	none	1	30	<2	beach north of settlement		
07/08/15	BJM_1008	479079	8518933	none	1	30	<2	beach north of settlement		
07/08/15	BJM_1009	478898	8519020	none	1	30	<2	beach/runoff from stream		
07/08/15	BJM_1010	478695	8519093	none	1	30	<2	2 samples from 'boat hull'		high
07/08/15	BJM_1011	478695	8519093	none	1	30	<2	2 samples from 'boat hull'		medium
08/08/15	BJM_1012	490031	8514762	none	3	30	<2	Near Thule on uplifted beach		low
08/08/15	BJM_1013	490209	8514611	none	1	30	<2	Beach grab		
12/08/15	15BJM001A	478691	8519096	560927	1	30	<2	Large bag to make concentrates		medium
12/08/15	15BJM002A	478832	8519050	560928	1	30	<2	Spade depth		high
12/08/15	15BJM003A	478769	8519075	560929	1	30	<2	Spade depth		high
12/08/15	15BJM004A	478623	8519112	560930	1	5	<2	Surface 5cm		high
12/08/15	15BJM004B	478623	8519112	560930	1	30	<2	Spade depth		
12/08/15	15BJM005A	478462	8519123	560931	1	30	<2	Spade depth		high
12/08/15	15BJM006A	478342	8519111	560932	1	30	<2	Spade depth		high
12/08/15	15BJM007A	478289	8519087	560933	1	30	<2	Spade depth		high
12/08/15	15BJM008A	478214	8519030	560934	1	30	<2	Spade depth		high
12/08/15	15BJM009A	478293	8519066	560935	1	2	<2	Top 2cm		high
12/08/15	15BJM009B	478289	8519072	560936	1	2	<2	Top 2cm		high
12/08/15	15BJM009C	478283	8519080	560937	1	2	<2	Top 2cm		high
12/08/15	15BJM009D	478282	8519090	560938	1	2	<2	Top 2cm		high
12/08/15	15BJM010A	478233	8519126	560939	1	5	<2	Top 5cm		high
12/08/15	15BJM011A	478015	8519487	560940	1	15	<2	Top 15cm		high
12/08/15	15BJM012A	478878	8519034	560941	1	30	<2	Spade depth		high
12/08/15	15BJM012B	478878	8519034	none	1	30	<2	Spade depth		high
12/08/15	15BJM013A	478872	8519014	560942	1	30	<2	Spade depth in intertidal area		high
12/08/15	15BJM014A	479031	8518954	560943	1	30	<2	Spade depth		high

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
12/08/15	15BJM015A	479228	8518861	560944	3	30	15	Spade depth up stream 75m		high
13/08/15	15BJM016A	479326	8518794	560945	2	30	<5	5m above tide/ spade depth		medium
13/08/15	15BJM018A	479476	8518727	560946	1	30	<2	Spade depth		medium
13/08/15	15BJM019A	479638	8518697	560947	3	30	20	Uplifted beach/ Spade depth/ 100m inland		medium
13/08/15	15BJM020A	479639	8518636	560948	3	5	20	Surface 5cm/ stream outlet/ 25m inland		high
13/08/15	15BJM021A	479662	8518564	560949				NO SAMPLE/ ROCK CHIP FOR GEUS		
13/08/15	15BJM022A	479797	8518552	560950	1	30	<2	Spade depth, with gravel		high
13/08/15	15BJM023A	479864	8518536	560951	1	5	<2	5cm deep		medium-high
13/08/15	15BJM024A	479797	8518504	560952	1	5	<2	Intertidal/ 5cm		medium
13/08/15	15BJM024B	479797	8518504	560953	1	30	<2	Spade depth		v pebbly surface, medium
13/08/15	15BJM025A	480155	8518386	560954	1	5	<2	Surface 5cm/ mouth of stream		medium
13/08/15	15BJM026A	480218	8518285	560955	1	30	<2	Spade depth		v pebbly surface, medium
13/08/15	15BJM027A	480564	8518201	560956	3	30	20	200m inland/ rocky sand on lake		trace
13/08/15	15BJM028A	480893	8518165	560957	3	30	25	200m inland/ rocky sand on lake		trace
13/08/15	15BJM029A	481012	8518208	560958	3	30	30	300m inland, vegetation area		medium
13/08/15	15BJM030A	481237	8518054	560959	1	30	<2	Stream mouth		low
13/08/15	15BJM031A	481433	8517983	560960	3	30	15	20m inland above rocky coast/ Spade depth		medium
13/08/15	15BJM032A	481472	8517919	560961	1	15	<2	Intertidal/ 15cm		medium
13/08/15	15BJM033A	481575	8517801	560962	1	30	<2	Waterline/ Spade depth No GEUS sample/ for concentrate/no BJM sample		medium
13/08/15	15BJM033B	481575	8517801	none	1	30	<2			
13/08/15	15BJM034A	481674	8517689	560963	2	30	<5	3m from high tide/ spade depth		medium
13/08/15	15BJM035A	484415	8516464	560964	2	30	<5	5m above tide/ spade depth		medium
13/08/15	15BJM036A	484209	8516630	560965	1	30	<2	Stream mouth/ 10m above tide/ spade depth		high
13/08/15	15BJM036B	484209	8516630	560966	1	30	<2	Intertidal/ spade depth		medium
13/08/15	15BJM037A	484051	8516713	560967	1	30	<2	Stream mouth/ Spade depth		medium
13/08/15	15BJM038A	483848	8516869	560968	3	30	10	50m up uplifted beach/ri 10m		high
13/08/15	15BJM039A	483723	8516779	560969	1	30	<2	Intertidal/ spade depth		high
13/08/15	15BJM040A	483575	8516806	560970	2	30	<5	Beach/ spade depth		high
13/08/15	15BJM041A	483346	8516880	560971	1	30	<2	Intertidal/ spade depth		medium
13/08/15	15BJM042A	483207	8517043	560972	2	30	<5	5m above tide/ spade depth		high
13/08/15	15BJM043A	482950	8517219	560973	2	30	<5	Beach/ spade depth		high
13/08/15	15BJM043B	482950	8517219	560974	1	30	<2	Intertidal/ spade depth		medium
13/08/15	15BJM044A	482828	8517295	560975	2	30	<5	Beach/ spade depth		medium

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
13/08/15	15BJM044B	482828	8517295	560976	1	5	<2	5cm deep		high
13/08/15	15BJM045A	482504	8517604	560977	2	30	<5	Top of tide mark		medium
14/08/15	15BJM046A	489295	8514289	560978	1	30	<2	Spade depth		medium
14/08/15	15BJM047A	489197	8514345	560979	1	30	<2	Intertidal/ spade depth		low
14/08/15	15BJM047B	489197	8514345	560980	2	30	<5	Beach/ spade depth		high
14/08/15	15BJM048A	488979	8514515	560981	2	30	<5	Beach/ spade depth		medium
14/08/15	15BJM049A	488875	8514610	560982	2	30	<5	Upper beach/ spade depth		medium
14/08/15	15BJM050A	488777	8514692	560983	1	30	<2	Intertidal/ spade depth		medium
14/08/15	15BJM050B	488777	8514692	560984	2	30	<5	Upper beach/ spade depth		medium
14/08/15	15BJM050C	488787	8514712	560985	3	30	15	On tundra 30m from water		low
14/08/15	15BJM051A	488674	8514780	560986	1	20	<2	Intertidal/ top 20cm		medium-high
14/08/15	15BJM052A	488602	8514850	560987	3	30	10	10m RL/ 30m inland/ tundra/ med sand, small pebbles		low-medium
14/08/15	15BJM053A	488465	8514914	560988	1	3	<2	Top 3cm		high
14/08/15	15BJM053B	488465	8514914	560989	1	30	<2	Spade depth		medium
14/08/15	15BJM054A	487924	8515188	560990	3	30	15	15m RL/ Tundra/ 30m from shore		medium
14/08/15	15BJM055A	487729	8515225	560991	3	30	12	Upper beach/ spade depth/ 12m RL/ inland 25m		medium
14/08/15	15BJM056A	487515	8515297	560992	2	30	<5	Beach/ spade depth		medium
14/08/15	15BJM057A	487478	8515460	560993	3	30	34	Uplifted beach/ 50m in/ RL 34m/ highest point of raised area		medium
14/08/15	15BJM058A	487127	8515546	560994	3	30	25	RL 25m/ 100m inland		low
14/08/15	15BJM059A	486787	8515591	560995	3	30	20	RL 20m/100m inland/ spade depth		low
14/08/15	15BJM060A	486769	8515596	560996	3	30	20	Stream sediment/ 20m RL		low
14/08/15	15BJM061A	486089	8515607	560997	3	30	10	10m RL/ 40m inland/ spade depth		low
14/08/15	15BJM062A	486079	8515688	560998	3	30	18	18m RL/ 100m inland		low
14/08/15	15BJM063A	486019	8515835	560999	3	30	31	31m RL/ 150m inland/ new sample book started		low
14/08/15	15BJM064A	485654	8515765	569501	1	30	<2	Intertidal/ spade depth		high
14/08/15	15BJM065A	485525	8515845	569502	1	30	<2	Intertidal/ spade depth		unsure
14/08/15	15BJM066A	485401	8515923	569503	1	30	<2	Intertidal/ spade depth		medium
14/08/15	15BJM066B	485401	8515923	569504	2	30	<5	Above tidal zone/ Spade depth		conc.
15/08/15	15BJM067A	478988	8518260	none				offshore/ Soft sediment collected at 51m	yes	mud
15/08/15	15BJM068A	478825	8518049	none				offshore/ Depth 34m	yes	mud
15/08/15	15BJM069A	479508	8518231	none				offshore	yes	mud

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
15/08/15	15BJM070A	479412	8518075	none				offshore	yes	mud
15/08/15	15BJM071A	479312	8517927	none				offshore	yes	mud
15/08/15	15BJM072A	479230	8517776	none				offshore	yes	mud
15/08/15	15BJM073A	479984	8518098	none				offshore	yes	mud
15/08/15	15BJM074A	479996	8517952	none				offshore	yes	mud
15/08/15	15BJM075A	479760	8517704	none				offshore	yes	mud
20/08/15	15BJM076A	501549	8511058	596531				backbeach, very silty		low
20/08/15	15BJM076B	501549	8511058	596532				back face, very silty and dark		low
20/08/15	15BJM077A	502419	8511092	596533				back face, very silty and dark		low
16/08/15	15BJM079A	490072	8513524	none				offshore	yes	mud
16/08/15	15BJM080A	490739	8513456	none				offshore	yes	mud
16/08/15	15BJM081A	490679	8513351	none				offshore	yes	mud
16/08/15	15BJM082A	491131	8513205	none	4			offshore		low
16/08/15	15BJM083A	491023	8513088	none				offshore	yes	mud
16/08/15	15BJM083B	492023	8513088	none	4					
20/08/15	15BJM084A	501970	8511545	none						low
20/08/15	15BJM085A	501707	8511626	none						
16/08/15	15BJM086A	491790	8512269	none				offshore	yes	mud
16/08/15	15BJM086B	491790	8512269	none	4					conc
20/08/15	15BJM087A	493175	8511413	none				conc		
20/08/15	15BJM087B	493175	8511413	none				conc		
16/08/15	15BJM088A	487749	8514752	none	4			offshore		mud
20/08/15	15BJM089A	491781	8512871	569535				conc		
16/08/15	15BJM090A	486668	8515126	none				offshore	yes	mud
16/08/15	15BJM090B	486668	8515126	none	4					low-med
17/08/15	15BJM091A	492523	8512323	569505	1	30	<2	Spade depth/ Intertidal		medium
17/08/15	15BJM092A	492678	8512143	569506	2	30	<5	Top of tide mark/ spade depth		
17/08/15	15BJM092B	492679	8512191	569507	1	30	<2	Intertidal/ spade depth		medium
17/08/15	15BJM093A	492985	8511684	569508	1	30	<2	Intertidal/ spade depth		medium
17/08/15	15BJM094A	493379	8511198	569509	1	30	<2	Intertidal/ spade depth		medium
17/08/15	15BJM094B	493379	8511198	none	1	30	<2	Uppertidal/ spade depth/ NO GEUS SAMPLE		
17/08/15	15BJM095A	494063	8511154	569510	1	30	<2	Uppertidal/ spade depth		low
17/08/15	15BJM096A	494095	8511217	569511	3	30	28	Spade depth RL 28m		low

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
17/08/15	15BJM097A	494332	8511297	569512	3	30	34	200m inland/ raised terrace side sample/ spade depth/ RL 34m		medium
17/08/15	15BJM097B	494472	8511297	569513	3	30	36	200m inland/ raised terrace side sample/ spade depth/ RL 36m		medium
17/08/15	15BJM098A	494472	8511112	569514	1	30	<2	Intertidal/ spade depth		trace
17/08/15	15BJM099A	494679	8511070	569515	1	30	<2	Intertidal/ spade depth		low
17/08/15	15BJM099B	494679	8511070	569516	1	30	<2	Intertidal/ spade depth		high
17/08/15	15BJM100A	495005	8511105	569517	1	30	<2	Intertidal/ spade depth		low
17/08/15	15BJM101A	495627	8511093	569518	1	30	<2	Uppertidal/ spade depth		low
17/08/15	15BJM102A	495818	8511142	569519	1	30	<2	Intertidal/ spade depth		low
17/08/15	15BJM103A	495942	8511256	569520	3	30	25	Raised beach/ 25m RL/ 100m inshore		low
17/08/15	15BJM104A	496713	8511235	569521	3	30	20	Raised beach		low
17/08/15	15BJM105A	494710	8510973	none	4			50m offshore 6m		?
17/08/15	15BJM106A	493425	8511002	none	4			100m offshore		?
18/08/15	15BJM107A	487882	8515085	none	4			Tied to seismic L7A Area 2A		present
18/08/15	15BJM108A	487853	8515070	none	4			Tied to seismic L7A Area 2A		low-medium
18/08/15	15BJM109A	487813	8515016	none	4			Tied to seismic L7A Area 2A/4m water		silty, ?
18/08/15	15BJM110A	487804	8514982	none	4			Tied to seismic L7A Area 2A/5-6m water		?
18/08/15	15BJM111A	487791	8514964	none	4			Tied to seismic L7A Area 2A/6m water		?
18/08/15	15BJM112A	487782	8514949	none	4			Tied to seismic L7A Area 2A/6m		?
18/08/15	15BJM113A	487767	8514902	none	4			Tied to seismic L7A Area 2A/8m		?
18/08/15	15BJM114A	488393	8514905	none	4			Off sandy beach/2.5m		visible
18/08/15	15BJM115A	488341	8514863	none	4			Off sandy beach/3m		silty, notable dk fraction
18/08/15	15BJM116A	488308	8514615	none	4			Off sandy beach/5m		?
18/08/15	15BJM117A	488245	8514805	none	4			Off sandy beach		?
18/08/15	15BJM118A	488227	8514752	none	4			Off sandy beach/5-6m		significant fine, angular, black fraction - metallics?
18/08/15	15BJM119A	488159	8514709	none	4			Off sandy beach/7m		?
18/08/15	15BJM120A	486811	8515436	none	4			Tied to seismic L5A/4m		low
18/08/15	15BJM121A	486742	8515278	none	4			Tied to seismic L5A/10m		silty w. v. fine black grains
18/08/15	15BJM122A	485406	8515940	569522	3	30	30	Uplifted terrace/ 30m RL		low-med
18/08/15	15BJM123A	485910	8515910	569523	3	30	42	Top terrace/ RL 42m/ spade depth		low
18/08/15	15BJM124A	485904	8515888	569524	3	30	39	2nd top terrace/ RL 39m/ spade depth		medium
18/08/15	15BJM125A	485897	8515869	569525	3	30	36	3rd top terrace/ RL 36m/ spade depth		medium
18/08/15	15BJM126A	485886	8515843	569526	3	30	32	4th top terrace/ RL 32m/ spade depth		low

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
18/08/15	15BJM127A	485872	8515813	569527	3	30	30	5th top terrace/ RL 30m/ spade depth		low-medium
18/08/15	15BJM128A	485844	8515752	569528	3	30	20	6th top terrace/ RL 20m/ spade depth		low
18/08/15	15BJM129A	485804	8515718	569529	3	30	17	7th top terrace/ RL 17m/ spade depth		low
18/08/15	15BJM130A	485787	8515693	569530	3	30	14	8th top terrace/ RL 14m/ spade depth		low
19/08/15	15BJM131A	489125	8514189	none	4			4m depth		sandy mud w. dk fraction
19/08/15	15BJM132A	489141	8514255	none	4			3m depth		wet, silty slurry w. some sand
19/08/15	15BJM133A	489172	8514107	none	4			7m depth		moderately sandy, dk grey mud charcoal coloured, plenty of black particles ?metallics?
19/08/15	15BJM134A	489278	8514098	none	4			4m depth		silty sand, quite stiff, but wet and loose on top. Plenty of dk black grains
19/08/15	15BJM135A	489353	8514063	none	4			3m depth		Silt w. v. fine black fraction
19/08/15	15BJM136A	489598	8514086	none	4			4m depth		Fine sand, significant metallics, silvery white mineral too.
19/08/15	15BJM137A	489734	8514088	none	4			1m depth		Fine sand. Metalliferous grains present. Low
19/08/15	15BJM138A	489772	8513974	none	4					Dk brown - charcoal fine sand. Relatively little silt.
19/08/15	15BJM139A	490260	8513666	none	4			3m		Similar to 139, notable metallics
19/08/15	15BJM140A	490755	8513593	none	4			0.5m		V. sandy, stiff, dk grey silt
19/08/15	15BJM141A	491193	8513313	none	4					Fine-med sand with obvious metallics, some lithic clasts
19/08/15	15BJM142A	491646	8512931	none	4					Fine sand, metallics present
19/08/15	15BJM143A	491395	8512899	none	4			3m		Fine silty sand with metallic fraction
19/08/15	15BJM144A	491580	8512870	none	4			5m		Moderately stiff brown silt / v. fine sand with black metallic fraction
19/08/15	15BJM145A	486184	8515350	none	4			12m		Sandy mud, grey brown colour, shelly organisms.
19/08/15	15BJM146A	486166	8515291	none	4			14m		Wet silt w. fine sand. Significant metallic fraction, smells organic.
19/08/15	15BJM147A	485731	8515581	none	4					Sandy silt w. fine black fraction
19/08/15	15BJM148A	485316	8515508	none	4					Sandy silt w. fine black fraction
19/08/15	15BJM149A	485217	8515655	none	4					Fine sand + metallics
19/08/15	15BJM150A	485354	8515782	none	4					Fine sand, metallics present
19/08/15	15BJM151A	485384	8515834	none	4			3m		V. fine, dk brown - grey sand
19/08/15	15BJM152A	484783	8515999	none	4			6m		Bioturbated, sandy mud / silt/
19/08/15	15BJM153A	484717	8515863	none	4			14m		V dk silt. Can't tell if metallics present
20/08/15	15BJM076A	501549	8511058	569531	1		30 <2			Notable dark fraction
20/08/15	15BJM076B	501549	8511058	569532	1		30 <2	Sampled to 40 cm		

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
20/08/15	15BJM077A	502417	8511092	569533	1	30	<2			Few metallics, if any
20/08/15	15BJM084A	501970	8511545	569534	1	30	<2			Mixed sand and clasts. Possibly some metallics. Unsure
20/08/15	15BJM085A	501707	8511626	569534	1	30	<2			V. stony dk brown sand. Top of active beach, natural ilmenite concentrate to >30cm along back wall of beach
20/08/15	15BJM087A	493175	8511413	none	1	30	<2			
20/08/15	15BJM089A	491781	8512871	none	1	30	<2			metallic+ ?cpx layers
20/08/15	15BJM154A	484125	8516437	none	4			7.1m		Fine sand and silt, ?metallics
20/08/15	15BJM155A	482988	8516695	none	4			14.0m		Sandy silt. Unsure if metallics within
20/08/15	15BJM156A	481386	8517750	none	4			5.9m		Sand with fine dk fraction.
20/08/15	15BJM157A	481307	8517686	none	4			11.4m		Silt w. v. fine black fraction
20/08/15	15BJM158A	480334	8518015	none	4			14.5m		Silt w. v. fine black fraction
20/08/15	15BJM159A	483883	8516803	569536	3	30		8 rl 8m		1st terract. Sand, medium brown. ?metallics
20/08/15	15BJM160A	483893	8516844	569537	3	30		12 rl 12m		10% dark fraction, medium grained sand.
20/08/15	15BJM161A	483906	8516901	569538	3	30		17 rl 17m		Fine sand. Dark fraction present. Low.
20/08/15	15BJM162A	483927	8517008	569539	3	30		26 rl 26m		Mixed medium-coarse sand with fine ?metallic fraction. Low
20/08/15	15BJM163A	483937	8517069	569540	3	30		31 rl 31m		Low. Mixed mineralogy sand.
20/08/15	15BJM164A	483981	8517147	569541	3	30		35 rl 35m		Soil bound by clayey lumps. Metallics present Coarse white sand, finer black grains.
20/08/15	15BJM165A	483993	8517185	569542	3	30		40 rl 40m		Low.
20/08/15	15BJM166A	484010	8517211	569543	3	30		44 rl 44m		Low
20/08/15	15BJM167A	484024	8517246	569544	3	30		47 rl 47m		Low
20/08/15	15BJM168A	484074	8517319	569545	3	30		56 rl 56m		Low
20/08/15	15BJM169A	484259	8517209	569546	3	30		60 rl 60m		Unsure of metallic fraction
20/08/15	15BJM170A	484242	8517174	569547	3	30		52 rl 52m		Low
20/08/15	15BJM171A	484216	8517126	569548	3	30		51 rl 51m		Trace
20/08/15	15BJM172A	484140	8517007	569549	3	30		35 rl 35m		V. fine and silty.
20/08/15	15BJM173A	484074	8516913	569550	3	30		29 rl 29m		High
20/08/15	15BJM174A	484026	8516823	569551	3	30		25 rl 25m		Fine sandy soil bound by clay. Unsure.
20/08/15	15BJM175A	484005	8516767	569552	3	30		21 rl 21m		Silt / clay soil with pebble and sand fraction. Metallics - low.
21/08/15	15BJM176A	479863	8519656	569553	3	30		70 rl 70m		Stony soil, trace metallics (verified by panning)

Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
21/08/15	15BJM177A	479878	8519617	569554	3	30	64	rl 64m		Few metallics in dk brown soil
21/08/15	15BJM178A	479864	8519586	569555	3	30	61	rl 61m		Medium. Dk brown to charcoal sand, mixed grains, some metallics
21/08/15	15BJM179A	479840	8519535	569556	3	30	58	rl 58m		Dk brown, sandy soil with metalliferous rich layer at 20cm depth
21/08/15	15BJM180A	479988	8519387	569557	3	30	49	rl 49m		Medium to high. Pebble free beneath top 10 cm.
21/08/15	15BJM181A	479981	8519358	569558	3	30	47	rl 47m		Fine sand. Low
21/08/15	15BJM182A	479966	8519297	569559	3	30	42	rl 42m		Medium on average, but with 10 cm thick concentrate layers of good quality metallics
21/08/15	15BJM183A	479957	8519244	569560	3	30	39	rl 39m		Low.
21/08/15	15BJM184A	479951	8519137	569561	3	30	33	rl 33m		Low
21/08/15	15BJM185A	479951	8518921	569562	3	30	29	rl 29m		Low
21/08/15	15BJM186A	479908	8518783	569563	3	30	24	rl 24m		Low
21/08/15	15BJM187A	488061	8514916	none	4			3.2m		Low
21/08/15	15BJM188A	487945	8514916	none	4			4.5m		Low
21/08/15	15BJM189A	488364	8514643	none	4			5.0m		Low
21/08/15	15BJM190A	488419	8514719	none	4			3m		Fine dk grey sand with some silt and clay, trace metallics
21/08/15	15BJM191A	488782	8514515	none	4			2.5m		Fine dk grey sand with some silt and clay, trace metallics
21/08/15	15BJM192A	488654	8514344	none	4			5.5m		Wet mud, medium sand fraction and some lithic fragments
21/08/15	15BJM193A	487511	8515161	none	4			3.5m		Med coarse sand. Notable metallics. Suggest assay, notably different from other offshore sites
22/08/15	15BJM194A	489812	8514702	569564	3	30	40	rl 40m terrace/ 50m inside		High, beneath pebble top layer
22/08/15	15BJM195A	490137	8514645	569565	3	30	<2	rl 1m top of tide mark		Medium, on beach face in intertidal zone
22/08/15	15BJM195B	490139	8514629	569566	1	30	<2	rl 1m/ intertidal		Low-medium on ridge crest.
22/08/15	15BJM195C	490135	8514623	569567	1	30	<2	Intertidal/ spade depth		Mixed mineralogy, medium sand, small metallic fraction. Pebbles within Layered (5 cm thick). Alternates between high and low
22/08/15	15BJM196A	490464	8514828	569568	3	30	20	100m inland/ raised		Pebbly, valley floor. Unsure on metallic fraction
22/08/15	15BJM197A	490648	8515036	569569	3	30	<2	in delta/ 300m from shore		Clast rich sand, few metallics if any
22/08/15	15BJM198A	490883	8514897	none	3	30	<2	middle of delta/ 400m from coast		Sand, few metallics if any
22/08/15	15BJM199A	491264	8514380	none	3	30	5	south east side/ 600m from coast near bank		?
23/08/15	15BJM200A	490087	8514710	569570	3	30	15	rl 15m side of a terrace		



Date	SampleNum	Easting mE	Northing mN	GEUSNo	Beach_environment	Sample Depth (cm)	RL (m)	Description	Discarded?	Notes / metallic fraction
23/08/15	15BJM201A	490593	8514820	none	3	30	12	taken lower on shoulder of terrace than 15BJM201B		Trace
23/08/15	15BJM201B	490593	8514820	none	3	30	17	taken higher on shoulder of terrace than 15BJM201A		More metallics than 201A, 10 m above river, coarse sand
23/08/15	15BJM202A	490547	8514810	none	3	30	3	top of terrace		Low
23/08/15	15BJM203A	491730	8515688	none	3	30	15	1.5km S/E in delta/ contained shell layer		Few metallics
23/08/15	15BJM204A	490620	8515167	none	3	30	15	N/E side of delta		No metallics seen in sample
23/08/15	15BJM205A	490364	8515161	none	3	30	15	N/E of raised terrace		Shelly beach sand. Few metallics if any
23/08/15	Con sample from Iterlak Delta	490091	8514781	none	3	30	30	large bag taken to make con		Concentrate from flat top of triangular terrace. Sample from 40cm.
Notes:										
UTM sample positions recorded in WGS 84 Zone 19N										
RL = Estimated altitude of sample position relative to sea level (GPS estimate)										
Sample depth: maximum depth of onshore sampling										
Metallic fraction: high = dark grey or brown to black, significant metallic fraction. Medium = mid grey to brown in colour, notable metallic fraction. Low = small metallic fraction present.										
Beach environment: 1 = intertidal, 2 = beach, above tide, 3 = raised terrace, typically vegetated, 4 = offshore										
Estimates of metallic fraction are qualitative and in some cases are influenced by a range of factors, such as clay content, whether the sample is wet or dry, lighting conditions.										