



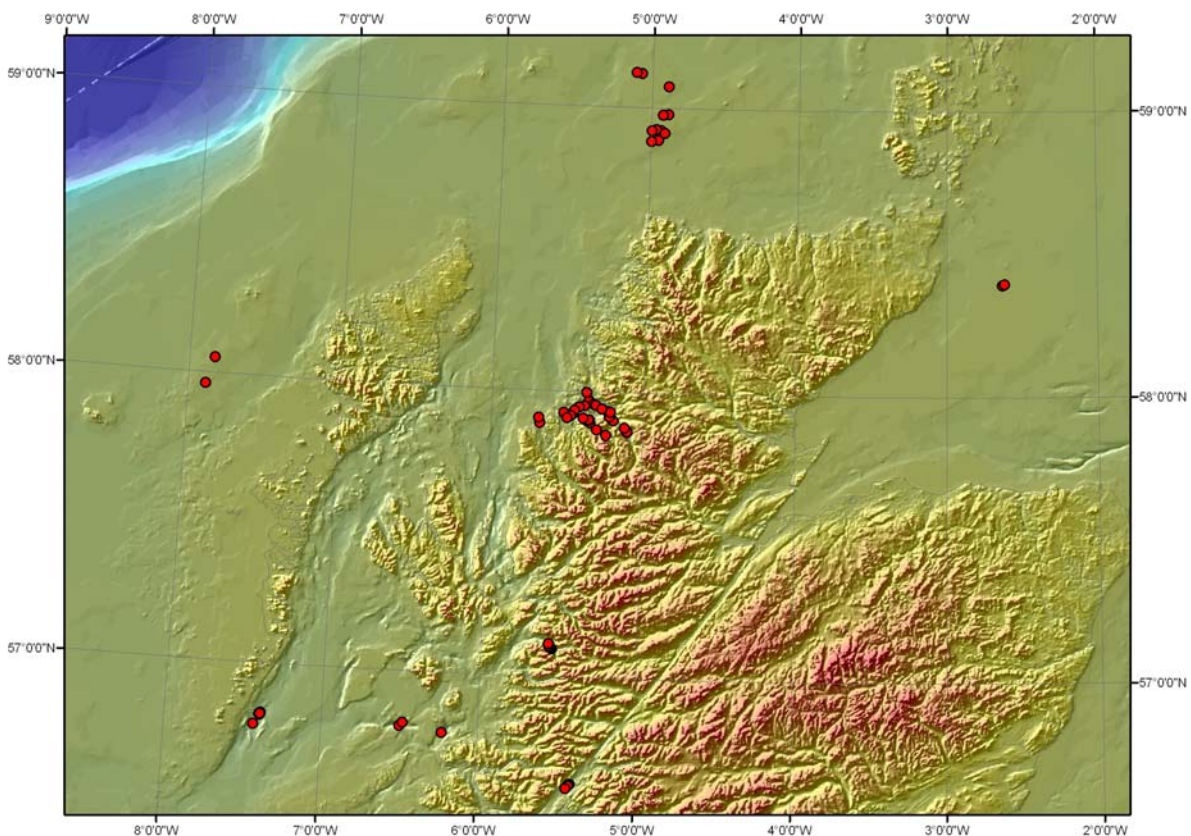
**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Preliminary geological results of sea-bed sampling in the Hebrides area from the *RRS James Cook* in 2007

Marine, Coastal and Hydrocarbons Programme

Internal Report IR/08/004



BRITISH GEOLOGICAL SURVEY

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INTERNAL REPORT IR/08/004

Preliminary geological results of sea-bed sampling in the Hebrides area from the *RRS James Cook* in 2007

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Front cover

Location of sample stations occupied during BGS cruise 2007/07.

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Foreword

This cruise report summarises operations onboard the *RRS James Cook* during the British Geological Survey (BGS) cruise 2007/07. The cruise took place between the 10th September and 13th October 2007 and collected data in the Moray Firth, Summer Isles, Nun Rock, Mingulay, Flannan, Loch Hourn, Loch Linnhe, Loch Nevis and island of Muck areas ([Figure 1](#)). The aim of the cruise was to collect sea-bed samples using the new BGS 15m rock-drill, BGS 6m vibrocorer, BGS gravity-corer and site specific multibeam data. This report provides a summary of operations and preliminary scientific observations. It includes details of shipboard personnel, location of all sample sites and a daily log of operations. It does not include details of post-cruise analyses.

Acknowledgements

The scientific party would like to thank the officers and crew of the *RRS James Cook*, and also the help of the National Marine Facilities (NMF) staff with pre-cruise planning and their welcome assistance during mobilisation and demobilisation.

Much of the scientific planning was completed by BGS staff who did not participate in the cruise. These include Ken Hitchen, Howard Johnson, Dave Long, Derek Ritchie, Martyn Stoker, Martin Quinn, Christian Wilson and Geoff Kimbell along with Heather Stewart who participated on the cruise.

Iain Pheasant, James Glendinning, Eileen Gillespie and Graham Tulloch provided help in preparing the equipment and logistics for this cruise.

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Summary

The aims of the *RRS James Cook* cruise were to collect sea-bed samples using the British Geological Survey (BGS) 15m rock-drill and to acquire site specific high-resolution multibeam echosounder data in the Moray Firth, Nun Rock, Flannan, Rosemary Bank, Lousy Bank and Hatton Bank areas. Unfortunately due to poor weather conditions the original work programme had to be modified. Sampling was successfully undertaken in the Moray Firth, Nun Rock and Flannan areas, with additional sampling carried out in the sheltered waters of the Summer Isles area, Mingulay, Loch Linnhe, Loch Hourn and island of Muck area. This cruise formed a key part of the BGS strategic mapping programme and was funded through the BGS Science Budget.

The revised work programme was highly successful with 274.10m of core collected from 101 sites using either the BGS 15m rock-drill, BGS 6m vibrocorer or the BGS gravity-corer ([Figure 1](#)). Additional multibeam echosounder data were collected to assist in locating individual sample sites for example in the Summer Isles area, or to build upon existing data.

1 Introduction

In 2007 the British Geological Survey (BGS) was awarded survey time on the NERC vessel the *RRS James Cook* under the command of Captain Robin Plumley. Originally the cruise aimed to carry out sea-bed sampling in the northern Atlantic Ocean, with the bulk of operations to be carried out on Hatton Bank. However, due to very poor weather conditions, most operations were carried out within the sheltered waters of the Inner Hebrides ([Figure 1](#)).

Aims

The modified aims of the cruise were:

- To test the 15m rock-drill in the Moray Firth at a location east of Wick where i) thin Holocene sediments overlie rockhead comprising Lower Cretaceous sediments, ii) thin Holocene sediments overlie glacial till deposits, and iii) Holocene sediments several metres in thickness overlie glacial till.
- To investigate the area immediately surrounding and to the north of Nun Rock located 28km north of Cape Wrath. Recently collected Maritime and Coastguard Agency multibeam echosounder data in the area of interest reveals extensive rock outcrop at sea bed. A linear feature observed on these data may be a northward extension of the Moine Thrust. A transect of 15m rock-drill sites across this feature, from footwall to hanging wall was proposed to test this hypothesis.
- To investigate a positive magnetic anomaly located immediately west of the Isle of Lewis (Outer Hebrides) on the Flannan High.
- To ground-truth a series of glacial moraines and intervening sediments using the 15m rock-drill, 6m vibrocorer and the BGS gravity-corer in the Summer Isles area. This work builds on the multibeam echosounder data and shallow seismic data collected during BGS cruise 2005/04 and shallow sea-bed samples collected during BGS cruise 2006/04.
- To deploy the 15m rock-drill and the 6m vibrocorer to sample the encrusting cold-water coral mounds located in The Minch near the island of Mingulay. These sample sites aim to determine the age of accumulation of these features, historic temperature variation during their evolution and to confirm the lithology of the bedrock to which the cold-water corals are anchored. The role of the representative from the Scottish Association for Marine Science (SAMS) was to ensure that no live cold-water coral was damaged during operations in this area. Using real-time video footage during deployment of the equipment allowed an accurate assessment of sea-bed conditions to be made.
- To determine the offshore extent of the Younger Dryas in the Loch Hourn, Loch Linnhe, Loch Nevis and the island of Muck area.

Site Selection and Numbering

In advance of the cruise an informal catalogue of potential sites were produced by Ken Hitchen, and Heather Stewart after consultation with other geologists. Each potential site was allocated a site number prefixed by one or two initials to designate the geologist who had selected that site (e.g. HS1, K211 etc). Where sites were chosen during operations the site number is prefixed with letters representing the location (e.g. LL represents Loch Linnhe, LH represents Loch Hourn).

AT	Adrian Tuitt	HS	Heather Stewart	SI	Martyn Stoker
DL	David Long	JDR	Derek Ritchie	MFQ	Martyn Quinn
GE	Geoff Kimbell	JH	John Howe	JB	James Bendle

HJ Howard Johnson

K Ken Hitchen

RG Robert Gatliff

Various datasets were used to select potential drill sites including existing BGS seismic datasets in the Hatton–Rockall area, Mingulay and Summer Isles area as well as multibeam echosounder data acquired by the Maritime and Coastguard Agency, SAMS and the Department of Trade and Industry Strategic Environmental Assessment.

As the original list of targets located in the deep-water areas west of Scotland were not visited during this cruise, the catalogue will remain on file and will be updated in expectation of a future BGS sampling cruise.

Once an attempt had been made at a particular site, an official BGS sample number was allocated. This comprises the latitude and longitude of the south-west corner of the degree square in which the sample was collected followed by an accession number (e.g. +56-08/927). The correlation between original site number and official BGS sample number is given in [Table 1](#). A summary of each site is given in [Table 2](#).

2 Report Organisation

This report is organised in official BGS sample number order (from +56-06/170VE to +59-06/397). For each sample there is a lithological summary log complete with site details. A sample photograph was taken for all rock-drill samples recovered. Note that the summary log is produced on the ship and will be subject to amendment as further work is carried out on the cores recovered.

Geological Personnel Involved

Robert Gatliff Shipboard Geologist

Heather Stewart Shipboard Geologist

Julia Crummy Shipboard Geologist and Data Manager

Table 1 Correlation of original site numbers to official BGS sample numbers.

Original Site Number	DGSQ Number	Original Site Number	DGSQ Number
DL1	+56-08/927	SI39	+57-06/268CS
DL6	+58-03/565	SI39	+57-06/268VE
DL7	+58-03/566	SI40	+57-06/257CS
DL10	+56-08/928	SI40	+57-06/258CS
DL11	+56-08/929	SI40	+57-06/258VE
DL11	+56-08/929VE	SI41	+57-06/270CS
DL12	+56-08/934VE	SI41	+57-06/270VE
DL13	+56-08/930VE	SI42	+57-06/273CS
DL14	+56-08/931VE	SI42	+57-06/273VE
DL15	+56-08/932VE	SI43	+57-06/287VE
DL16	+56-08/933VE	SI44	+57-06/275CS
DL17	+56-08/935VE	SI45	+57-06/280VE
DL18	+56-08/936VE	SI46	+57-06/262
JB1	+57-06/276CS	SI46	+57-06/262VE
JB1	+57-06/276VE	SI47	+57-06/263
JB2	+57-06/274CS	SI47	+57-06/263VE
JB2	+57-06/274VE	SI48	+57-06/271
JB3	+57-06/272CS	SI48	+57-06/271VE
JB3	+57-06/272VE	SI49	+57-06/256
JDR3	+58-05/389	SI49	+57-06/256VE
JDR4	+58-05/397	SI49	+57-06/288VE
JDR5	+58-05/390	SI50	+57-06/254
JDR6	+58-05/391	SI50	+57-06/254VE
JDR7	+59-05/317	SI51	+57-06/255
JDR8	+59-06/395	SI51	+57-06/255VE
JDR8	+59-06/396	SI52	+57-06/266CS
JDR9	+59-06/397	SI52	+57-06/267CS
JDR11	+58-08/231	SI52	+57-06/267VE
JDR13	+57-08/487	SI53	+57-06/264CS
JDR14	+58-05/392	SI53	+57-06/264VE
JDR14	+58-05/393	SI53	+57-06/265CS
JDR15	+58-05/394	SI54	+57-06/269CS
JDR16	+58-05/396	SI54	+57-06/269VE

Original Site Number	DGSQ Number
JDR17	+58-05/395
JDR18	+58-05/398
JH2	+56-07/726VE
JH5	+56-07/728VE
JH6	+56-07/727VE
LH1	+57-06/292VE
LH2	+57-06/293VE
LH3	+57-06/294VE
LH4	+57-06/295VE
LH5	+57-06/296VE
LH6	+57-06/297VE
LH7	+57-06/298VE
LL1	+56-06/173VE
LL2	+56-06/172VE
LL3	+56-06/171VE
LL4	+56-06/170VE
LL5	+56-06/174VE
RG1	+57-06/289VE

Original Site Number	DGSQ Number
SI56	+57-06/281VE
SI57	+57-06/277VE
SI58	+57-06/278VE
SI59	+57-06/279VE
SI60	+57-06/286VE
SI61	+57-06/259CS
SI61	+57-06/259VE
SI62	+57-06/260CS
SI62	+57-06/260VE
SI63	+57-06/261CS
SI63	+57-06/261VE
SI63	+57-06/283VE
SI64	+57-06/282VE
SI66	+57-06/291VE
SI67	+57-06/290VE
SI68	+57-06/284VE
SI69	+57-06/285VE

Sample numbers appended with 'CS' indicate a gravity-core site, 'VE' indicate a 6m vibrocorer site, and those without a two letter qualifier indicate a 15m rock-drill site.

Table 2 Summary of site details

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
+56-06/170VE LL4	3.68 2.94	Loch Linnhe	56.62853° N 5.40238° W	85	Dark grey clay
+56-06/171VE LL3	0 0	Loch Linnhe	56.6257° N 5.40741° W	75	No recovery
+56-06/172VE LL2	0 0	Loch Linnhe	56.6249° N 5.40867° W	63	No recovery
+56-06/173VE LL1	5.9 4.39	Loch Linnhe	56.62219° N 5.41288° W	93	Dark grey clay
+56-06/174VE LL5	6.07 4.15	Loch Linnhe	56.6122° N 5.42883° W	70.5	Dark grey clay
+56-07/726VE JH2	6.08 5.26	Muck South	56.790313° N 6.2273° W	198.5	Grey slightly sandy clay
+56-07/727VE JH6	5.92 4.81	Muck Deep	56.808823° N 6.499012° W	249	Grey clay
+56-07/728VE JH5	6.08 4.16	Muck Deep	56.819221° N 6.479233° W	185.5	Grey clay
+56-08/927 DL1	1.82 0.6	Mingulay	56.821686° N 7.392135° W	123.5	Coral fragments in a coarse-grained shelly sand matrix overlying dolerite
+56-08/928 DL10	1.83 0.1	Mingulay	56.78556° N 7.43009° W	135.5	Dead coral fragments. Largest fragment recovered 6cm long
+56-08/929 DL11	0.1 0.1	Mingulay	56.821843° N 7.390719° W	120	Large coral fragments in a mud matrix
+56-08/929VE DL11	3.89 3.61	Mingulay	56.82184° N 7.390705° W	127	Dark grey clay with coral fragments
+56-08/930VE DL13	5.98 5.25	Mingulay	56.8221° N 7.396483° W	134	Dark grey clay with coral fragments
+56-08/931VE DL14	0 0	Mingulay	56.819995° N 7.393308° W	120	No recovery
+56-08/932VE DL15	1.0 0	Mingulay	56.82666° N 7.389168° W	179	No recovery
+56-08/933VE DL16	1.0 0.49	Mingulay	56.823166° N 7.391666° W	134	Dark grey clay

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
+56-08/934VE DL12	0 0	Mingulay	56.8222° N 7.395953° W	139	No recovery
+56-08/935VE DL17	0 0	Mingulay	56.820816° N 7.3906° W	129.5	No recovery
+56-08/936VE DL18	4.86 2.76	Mingulay	56.822351° N 7.390504° W	124	Coral fragments in sandy mud
+57-06/254 SI50	6.7 6.7	Summer Isles	57.8870875° N 5.6786105° W	36	Sand with assorted pebbles and gravel
+57-06/254VE SI50	6.04 2.46	Summer Isles	57.887101° N 5.678586° W	33.5	Shelly, sandy mud
+57-06/255 SI51	5.1 1.09	Summer Isles	57.9058035° N 5.6887591° W	34	Shelly, gravelly sand overlying boulder clay
+57-06/255VE SI51	5.92 5.92	Summer Isles	57.905798° N 5.688801° W	33	Boulder clay
+57-06/256 SI49	3.99 2.03	Summer Isles	57.907867° N 5.5000337° W	34.5	Shelly sand with assorted pebbles and gravel
+57-06/256VE SI49	2.63 1.64	Summer Isles	57.9079° N 5.50000° W	35	Fine-grained sand with pebbles
+57-06/257CS SI40	3.26 3.26	Summer Isles	57.868596° N 5.303785° W	102	Dark grey clay
+57-06/258CS SI40	3.37 3.37	Summer Isles	57.868485° N 5.303866° W	102	Dark grey clay
+57-06/258VE SI40	6.05 3.71	Summer Isles	57.8686° N 5.303783° W	103.5	Dark grey clay
+57-06/259CS SI61	3.65 3.65	Summer Isles	57.899503° N 5.369998° W	74.5	Dark grey clay
+57-06/259VE SI61	6.08 3.3	Summer Isles	57.89951° N 5.369991° W	73	Slightly silty, shelly mud
+57-06/260CS SI62	3.59 3.59	Summer Isles	57.89521° N 5.356923° W	75.5	Dark grey clay
+57-06/260VE SI62	6.07 3.91	Summer Isles	57.895215° N 5.356885° W	74	Dark grey clay
+57-06/261CS SI63	0 0	Summer Isles	57.89231° N 5.348316° W	56.5	No recovery

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
+57-06/261VE SI63	6.07 2.69	Summer Isles	57.892305° N 5.348315° W	57	Dark grey clay
+57-06/262 SI46	9.35 1.97	Summer Isles	57.968096° N 5.357871° W	51.5	Shelly sand with assorted pebbles and gravel
+57-06/262VE SI46	5.87 4.74	Summer Isles	57.96924° N 5.360921° W	48.5	Dark grey clay
+57-06/263 SI47	10.26 3.43	Summer Isles	57.957897° N 5.327373° W	44	Slightly sandy clay with bands of shell fragments overlying boulder clay
+57-06/263VE SI47	c. 5.7 4.54	Summer Isles	57.9579° N 5.327391° W	37	Pebbly clay
+57-06/264CS SI53	2.68 2.68	Summer Isles	57.8626° N 5.10383° W	49.5	Dark grey clay
+57-06/264VE SI53	5.37 3.33	Summer Isles	57.862803° N 5.103686° W	49	Dark grey clay
+57-06/265CS SI53	2.44 2.44	Summer Isles	57.862798° N 5.103833° W	49.5	Dark grey clay
+57-06/266CS SI52	1.67 1.67	Summer Isles	57.8655° N 5.106191° W	49	Dark grey clay
+57-06/267CS SI52	1.71 1.71	Summer Isles	57.8655° N 5.106206° W	49.5	Dark grey clay
+57-06/267VE SI52	5.38 4.73	Summer Isles	57.865511° N 5.10625° W	49	Grey sand with pebbly sand at base
+57-06/268CS SI39	2.89 2.89	Summer Isles	57.90275° N 5.196991° W	66.5	Dark grey clay
+57-06/268VE SI39	6.04 3.41	Summer Isles	57.902705° N 5.197008° W	64	Dark grey clay
+57-06/269CS SI54	2.37 2.37	Summer Isles	57.91441° N 5.221276° W	83	Dark grey clay
+57-06/269VE SI54	c. 6.0 4.96	Summer Isles	57.914418° N 5.221316° W	83	Dark grey clay
+57-06/270CS SI41	3.11 3.11	Summer Isles	57.936401° N 5.2378° W	65.5	Dark grey clay
+57-06/270VE SI41	6.05 3.22	Summer Isles	57.936398° N 5.237783° W	65.5	Dark grey clay

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
+57-06/271 SI48	6.57 3.08	Summer Isles	57.955699° N 5.312141° W	34.5	Light grey clay with shell and rock fragments, pebbles at base
+57-06/271VE SI48	c. 5.6 4.49	Summer Isles	57.95463° N 5.31451° W	32	Dark grey clay
+57-06/272CS JB3	3.05 3.05	Summer Isles	57.951118° N 5.385915° W	139	Dark grey clay
+57-06/272VE JB3	6.05 2.99	Summer Isles	57.951121° N 5.38591° W	138	Dark grey clay
+57-06/273CS SI42	3.06 3.06	Summer Isles	57.946575° N 5.422715° W	143	Dark grey clay
+57-06/273VE SI42	6.03 3.34	Summer Isles	57.946575° N 5.42269° W	145.5	Dark grey clay
+57-06/274CS JB2	3.14 3.14	Summer Isles	57.923733° N 5.460416° W	117	Dark grey clay
+57-06/274VE JB2	6.08 3.74	Summer Isles	57.92374° N 5.460398° W	117.5	Dark grey clay
+57-06/275CS SI44	3.24 3.24	Summer Isles	57.918598° N 5.490198° W	119	Dark grey clay
+57-06/276CS JB1	3.06 3.06	Summer Isles	57.926285° N 5.522648° W	178	Dark grey clay
+57-06/276VE JB1	6.07 4.42	Summer Isles	57.926283° N 5.522616° W	180	Shelly clay
+57-06/277VE SI57	c. 5.7 4.64	Summer Isles	57.941706° N 5.269593° W	77	Dark grey clay
+57-06/278VE SI58	c. 5.3 3.98	Summer Isles	57.942103° N 5.27174° W	78	Dark grey clay
+57-06/279VE SI59	c. 5.7 3.52	Summer Isles	57.942201° N 5.272801° W	77.5	Dark grey clay
+57-06/280VE SI45	c. 6.07 3.62	Summer Isles	57.998096° N 5.378085° W	80.5	Dark grey clay
+57-06/281VE SI56	5.98 4.2	Summer Isles	57.9348° N 5.4549° W	98	Greyish brown clay
+57-06/282VE SI64	6.01 3.66	Summer Isles	57.8504° N 5.2421° W	39.5	Dark grey clay

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
+57-06/283VE SI63	6.08 2.81	Summer Isles	57.892298° N 5.348295° W	56	Dark grey clay
+57-06/284VE SI68	c.5.9 4.6	Summer Isles	57.901233° N 5.351706° W	46	Pebbly clay
+57-06/285VE SI69	1.0 0.3	Summer Isles	57.902908° N 5.36098° W	40.5	Pebbly, muddy sand
+57-06/286VE SI60	5.83 2.77	Summer Isles	57.9079° N 5.39568° W	54	Medium- to coarse-grained sand
+57-06/287VE SI43	5.95 4.04	Summer Isles	57.916083° N 5.477683° W	106	Dark grey clay
+57-06/288VE SI49	2.9 1.69	Summer Isles	57.9079° N 5.5000° W	35	Fine-grained sand with pebbles
+57-06/289VE RG1	5.53 3.55	Summer Isles	57.864631° N 5.105373° W	54	Dark grey clay
+57-06/290VE SI67	1.52 0.3	Summer Isles	57.876778° N 5.123685° W	20	Dark grey clay
+57-06/291VE SI66	5.9 5.09	Summer Isles	57.932796° N 5.217841° W	43.5	Dark grey clay
+57-06/292VE LH1	5.79 4.58	Loch Hourn	57.099065° N 5.54625° W	53	Grey clay overlying medium-grained sand
+57-06/293VE LH2	c. 6.02 4.27	Loch Hourn	57.103641° N 5.554113° W	55	Grey clay becoming sandy towards base of core
+57-06/294VE LH3	6.07 3.65	Loch Hourn	57.10563° N 5.557296° W	78	Grey clay
+57-06/295VE LH4	6.06 4.0	Loch Hourn	57.108226° N 5.562568° W	91	Grey clay, sandy at base
+57-06/296VE LH5	6.07 3.79	Loch Hourn	57.116208° N 5.56358° W	92	Grey clay
+57-06/297VE LH6	5.97 4.28	Loch Hourn	57.11807° N 5.568716° W	96	Grey clay
+57-06/298VE LH7	6.1 3.91	Loch Hourn	57.11722° N 5.566411° W	98	Grey clay
+57-08/487 JDR13	1.51 0.89	Flannan	57.962569° N 7.8864° W	66	Shelly coarse sand on boulder clay

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
+58-03/565 DL6	3.89 1.47	Moray Firth	58.3933977° N 2.6343779° W	63	Unconsolidated sand overlying boulder clay
+58-03/566 DL7	1.95 0.67	Moray Firth	58.3968428° N 2.6206904° W	56.5	Unconsolidated shelly sand overlying boulder clay
+58-05/389 JDR3	0.79 0.48	Nun Rock	58.921170° N 4.99759° W	50.5	Ice-rafted cobbles of Lewisian/Cambrian(?) origin
+58-05/390 JDR5	1.98 1.46	Nun Rock	58.922123° N 4.935873° W	43	Pegmatite
+58-05/391 JDR6	1.3 1.3	Nun Rock	58.98° N 4.89° W	50	Fine-grained granite
+58-05/392 JDR14	1.6 0.93	Nun Rock	58.925031° N 4.969857° W	54	Boulders
+58-05/393 JDR14	0.44 0.44	Nun Rock	58.925058° N 4.970093° W	52	Banded gneiss with fractures occurring preferentially along compositional banding.
+58-05/394 JDR15	0.78 1.03	Nun Rock	58.921173° N 4.997585° W	50.5	Boulders overlying pegmatite
+58-05/395 JDR17	1.39 1.39	Nun Rock	58.976429° N 4.923643° W	51	Banded gneiss
+58-05/396 JDR16	2.45 1.89	Nun Rock	58.914055° N 4.909838° W	48	Fine-medium grained granite
+58-05/397 JDR4	1.27 1.16	Nun Rock	58.887661° N 4.952161° W	33	Meta-diorite
+58-05/398 JDR18	2.98 2.79	Nun Rock	58.88318° N 4.998317° W	43	Schist with compositional banding
+58-08/231 JDR11	2.18 1.69	Flannan	58.0537° N 7.8356° W	49.5	Granitic gneiss
+59-05/317 JDR7	2.66 2.13	Nun Rock	59.076954° N 4.890199° W	51.5	Schist
+59-06/395 JDR8	0 0	Nun Rock	59.1206° N 5.07445° W	53	No recovery
+59-06/396 JDR8	1.12 1.23	Nun Rock	59.120734° N 5.074679° W	55	Lewisian/Moine granite(?)
+59-06/397	1.24	Nun Rock	59.123644° N	53	Amphibole-mica schist

Sample Number	TD (m) Core (m)	Location	Lat/Long	WD (m)	Summary
JDR9	1.12		5.110327° W		

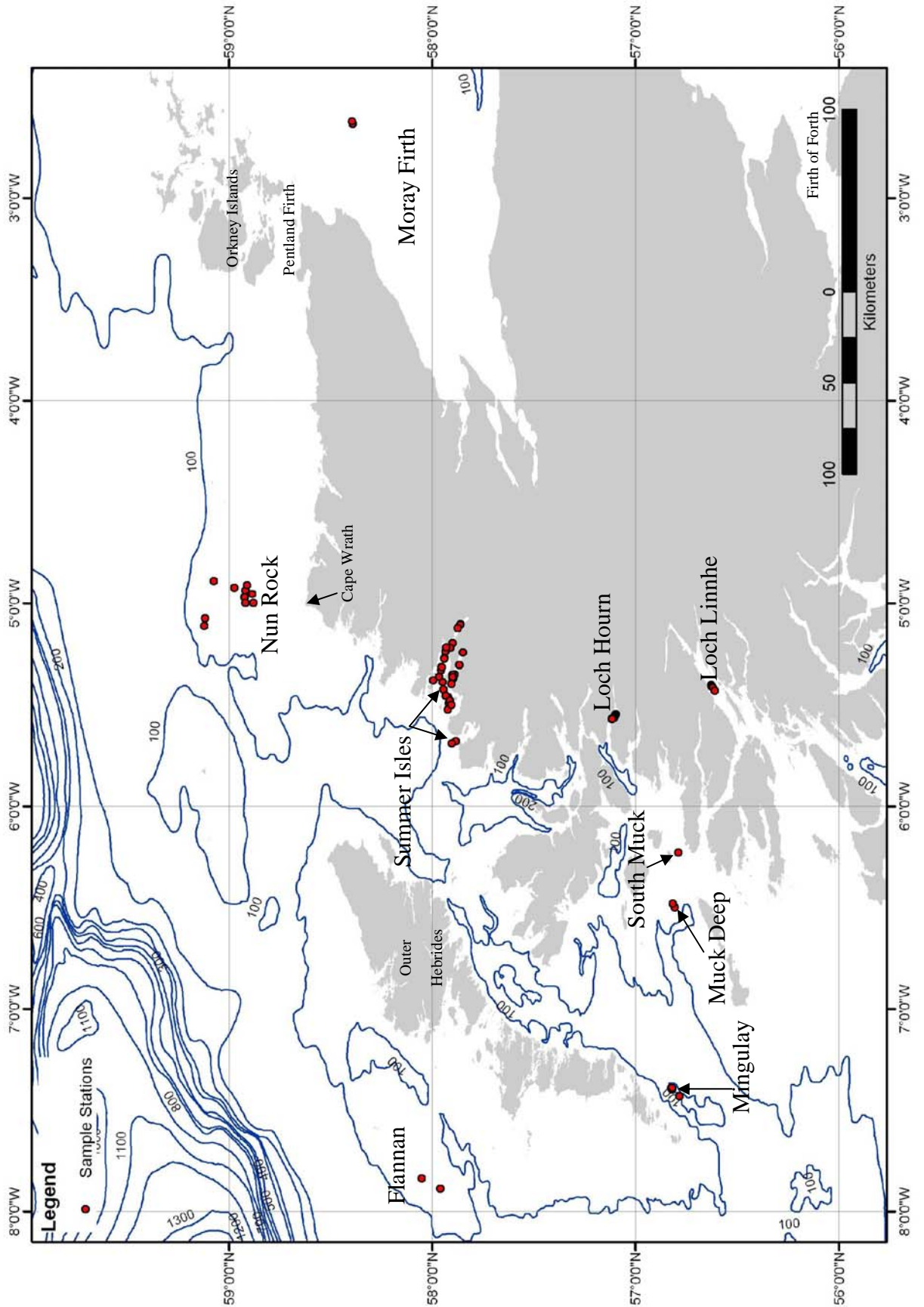


Figure 1 Sample locations.

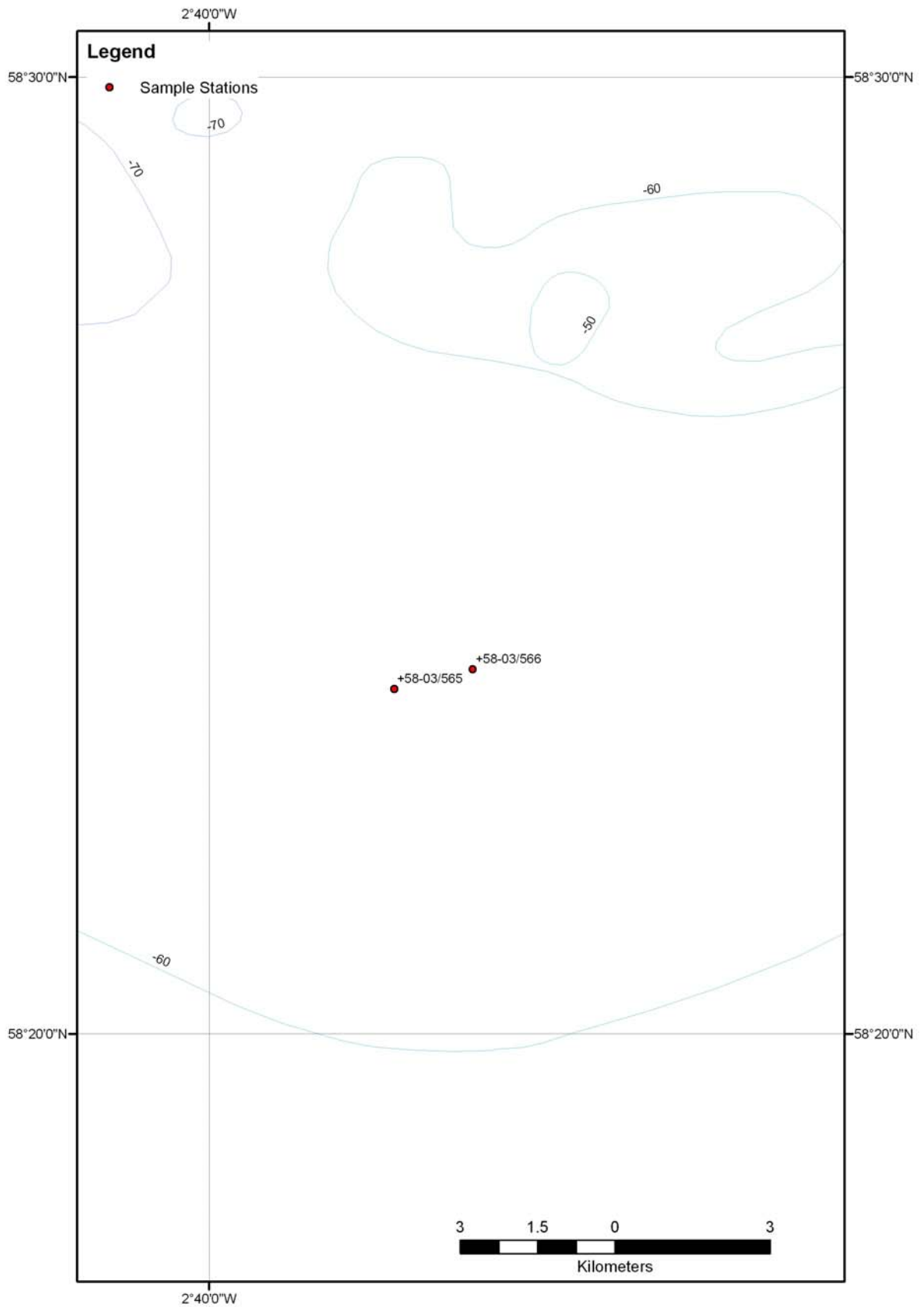


Figure 2 Sample site map for the Moray Firth area east of Wick.

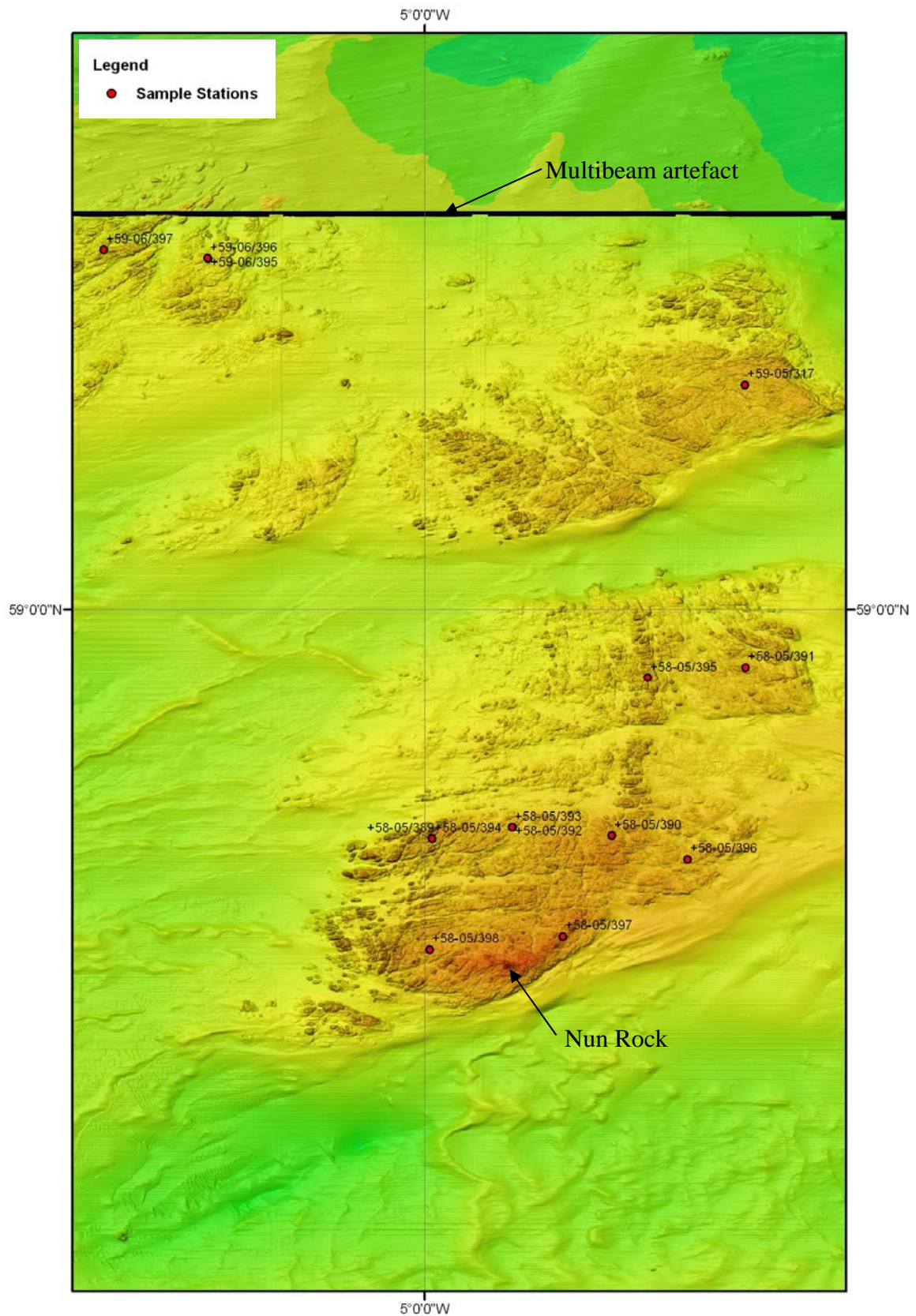


Figure 3 Sample site map for the Nun Rock area, located to the north of Cape Wrath. The multibeam data displayed are courtesy of the Maritime and Coastguard Agency.

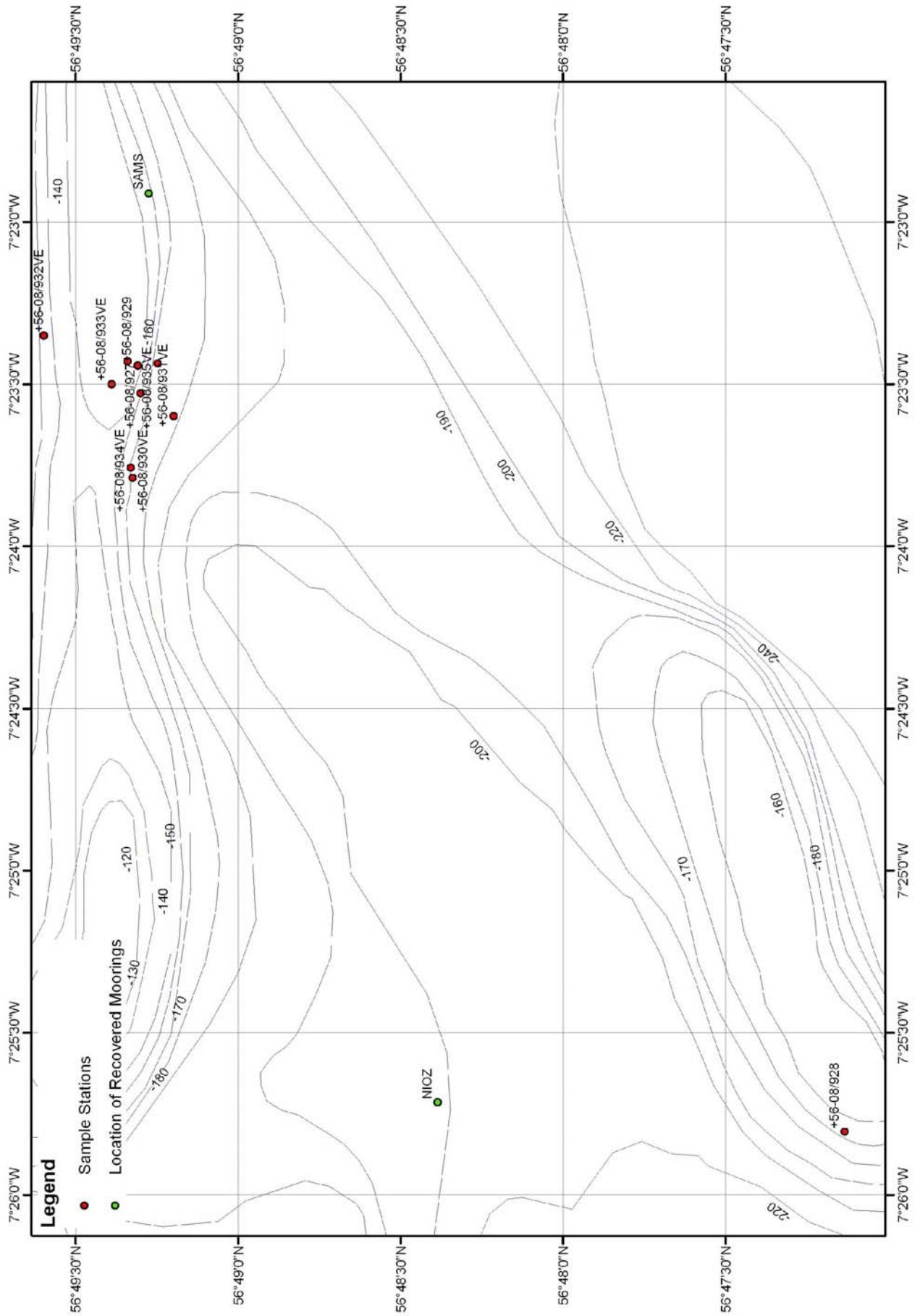


Figure 5 Sample site map for the Mingulay area.

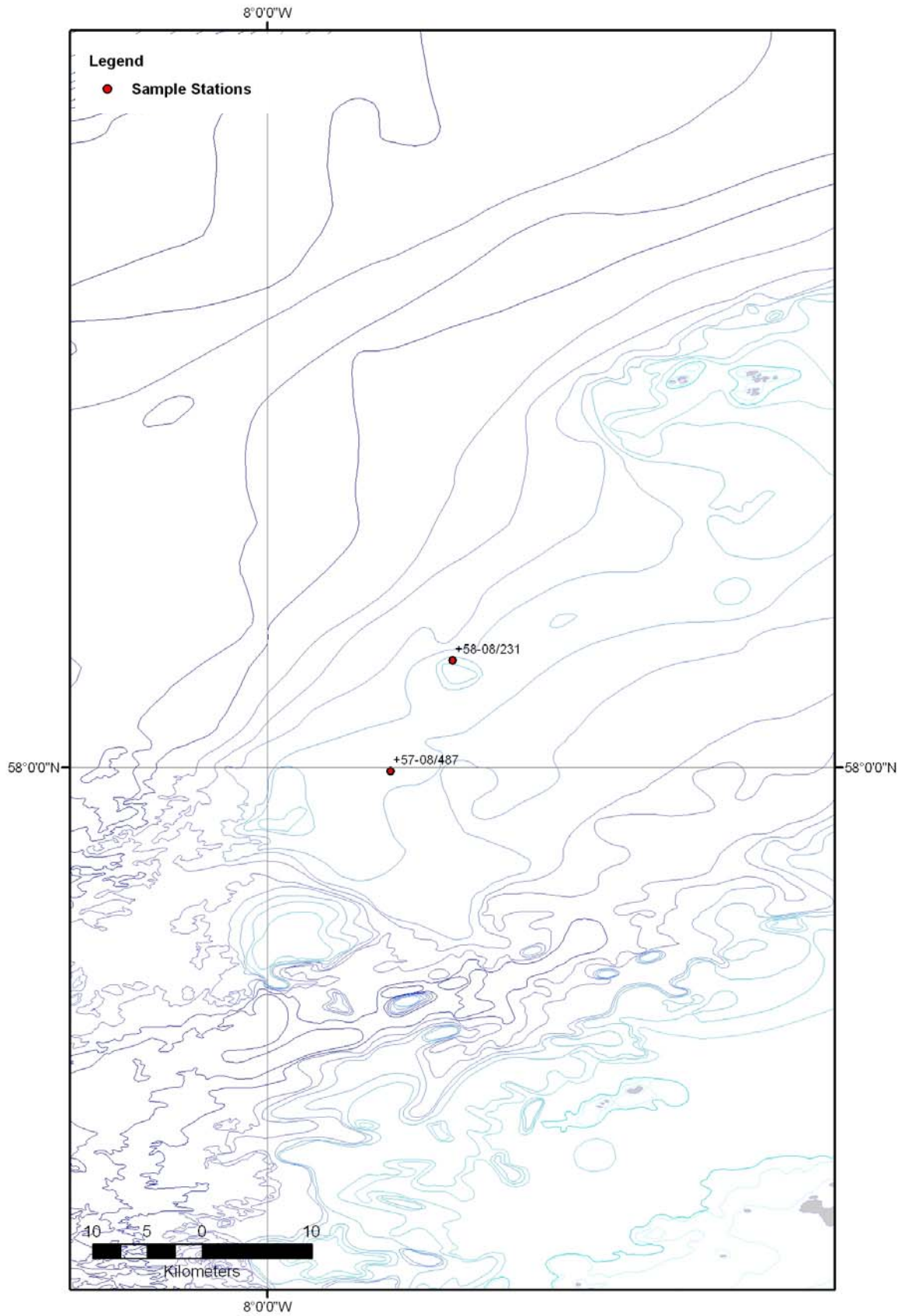


Figure 6 Sample site map for the Flannan area, located to the west of the Outer Hebrides.

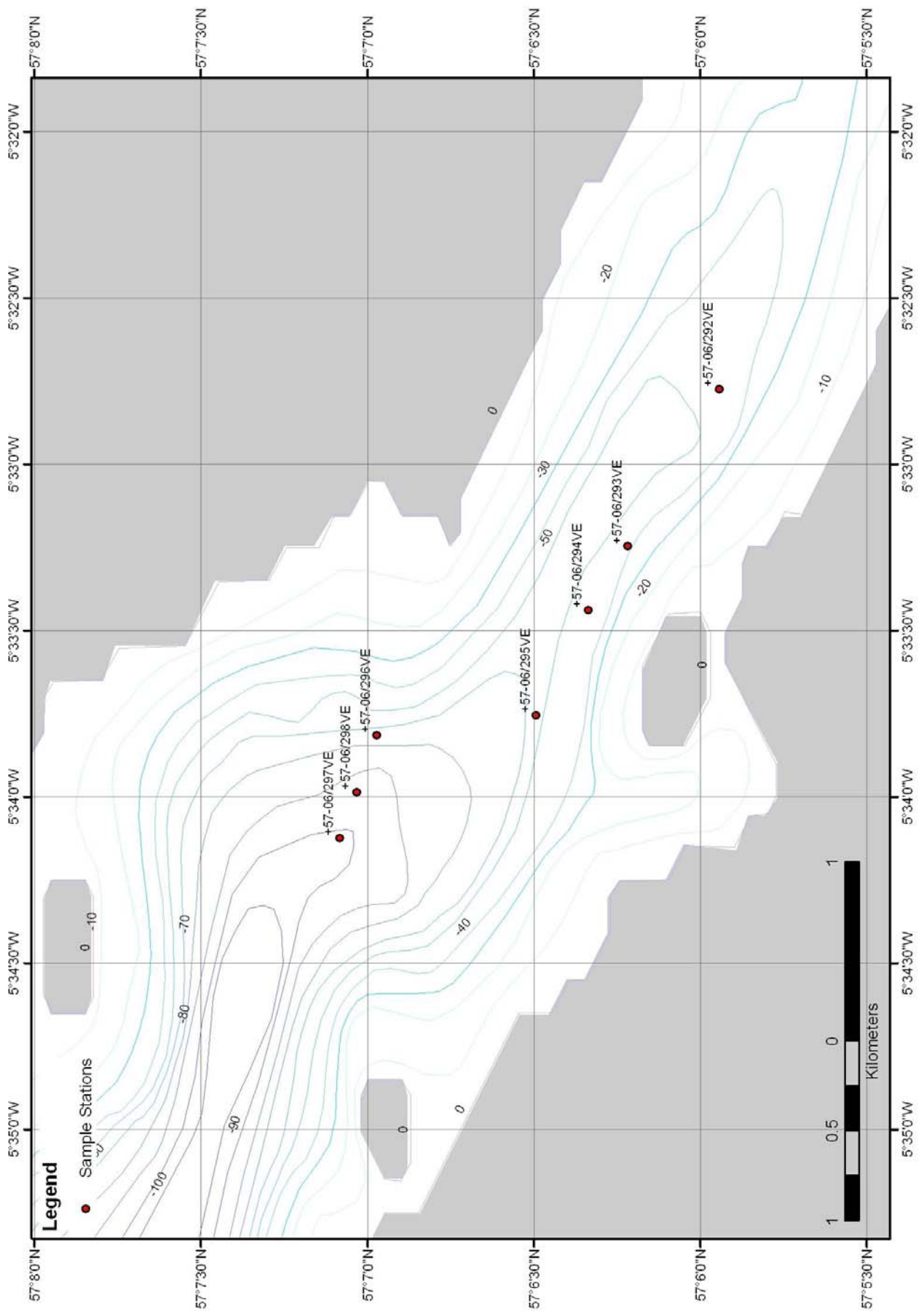


Figure 7 Sample site map for the Loch Hour area.

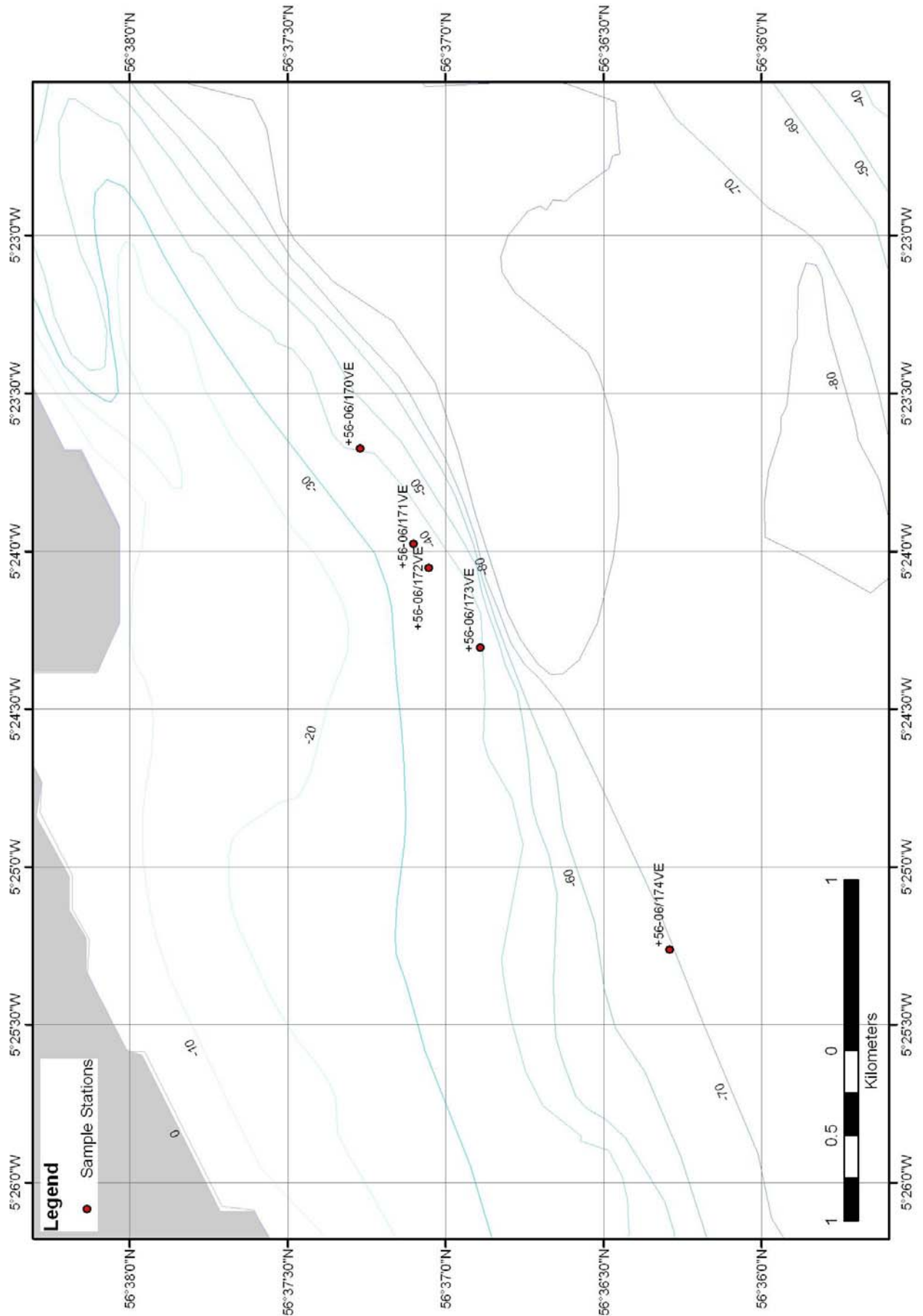


Figure 8 Sample site map for the Loch Linnhe area.

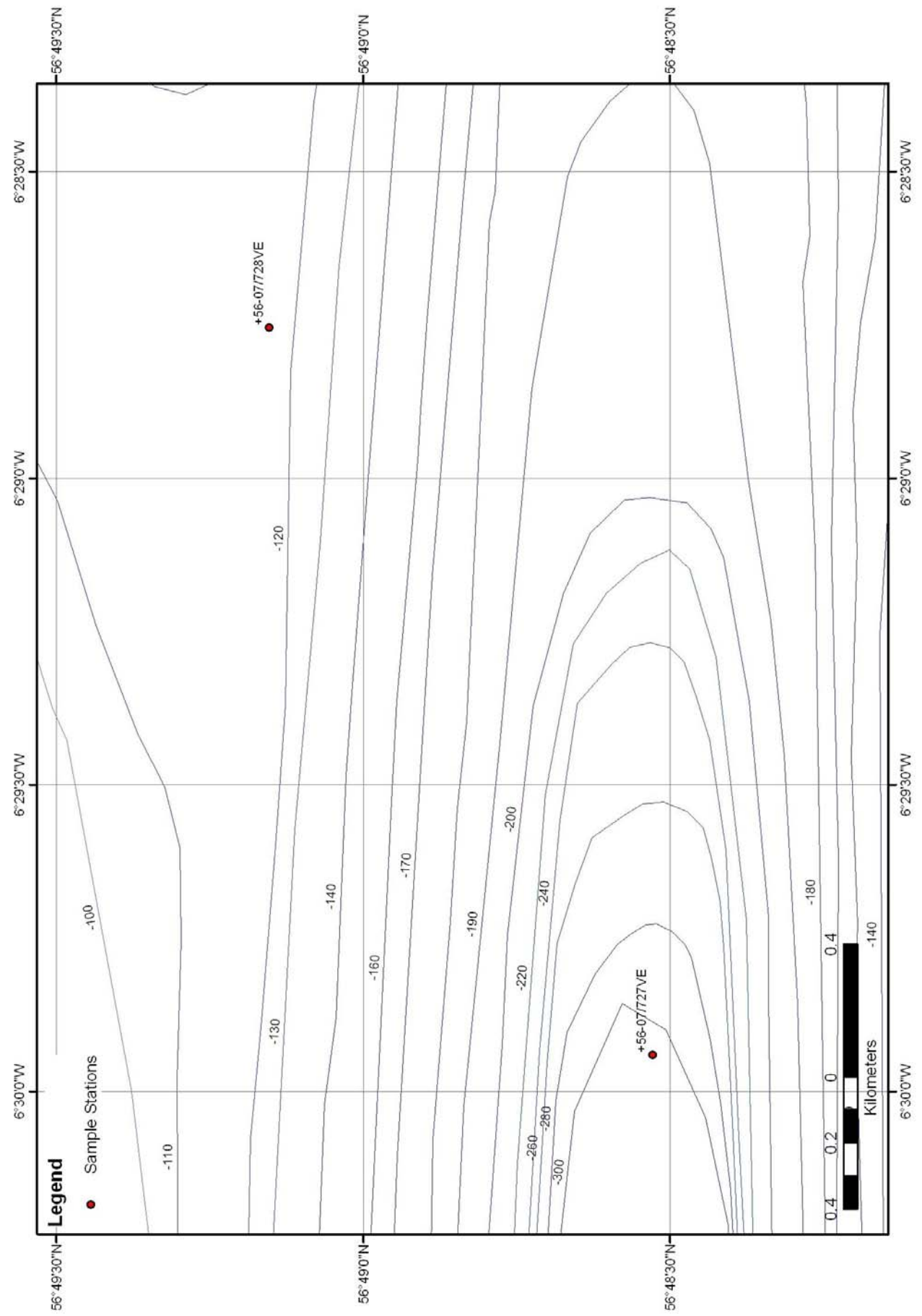


Figure 9 Sample site map for the Muck Deep area.

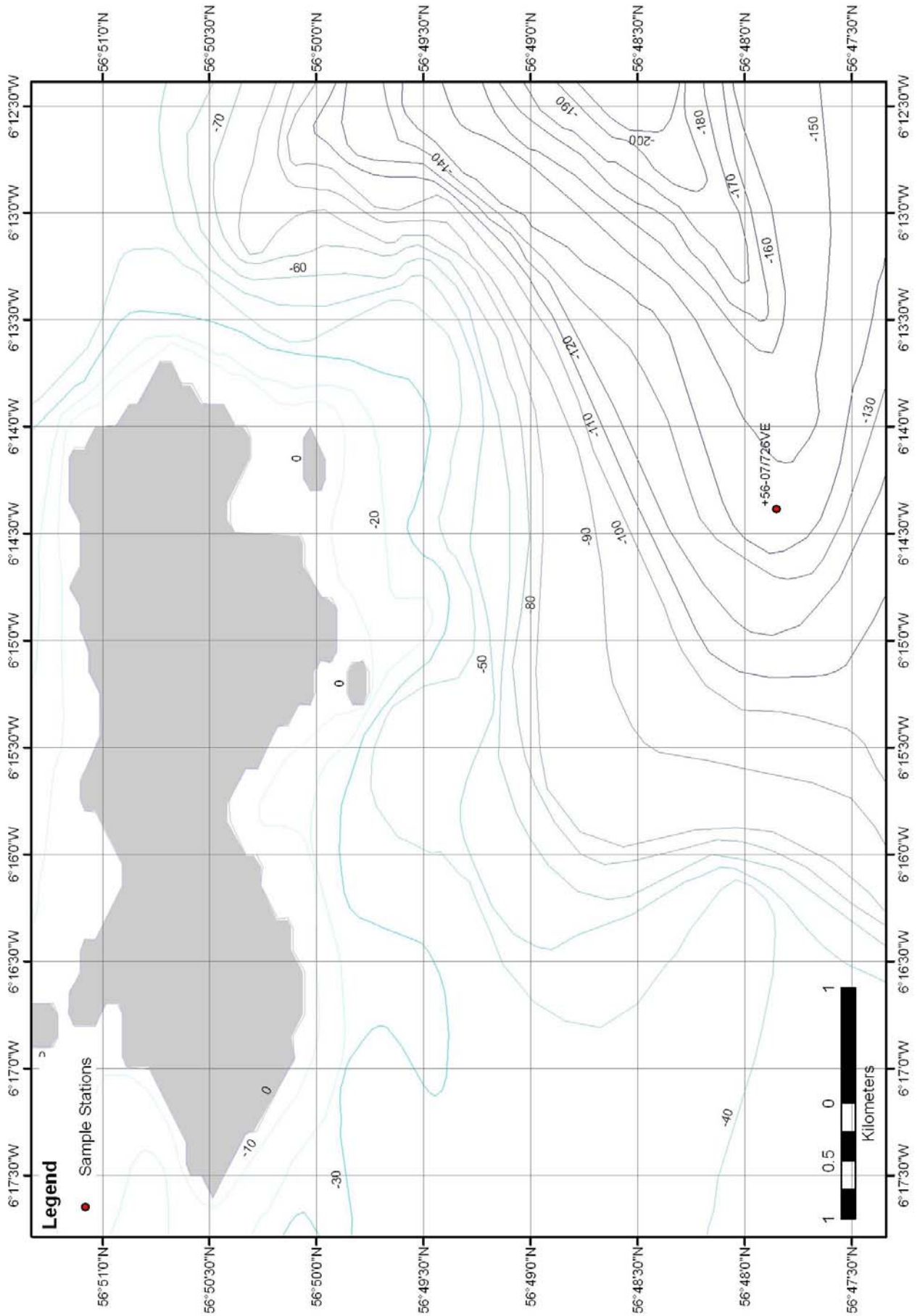
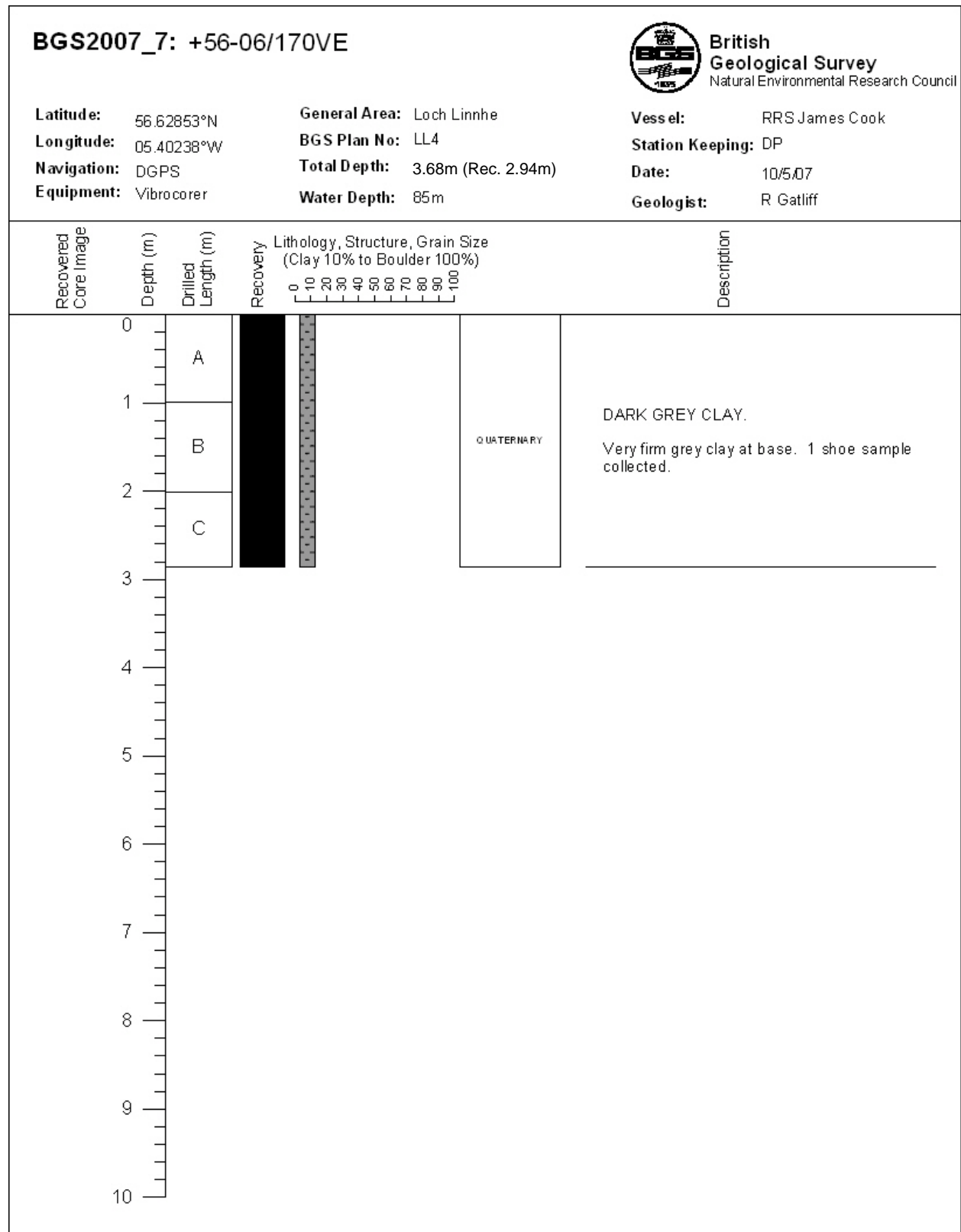


Figure 10 Sample site map for the South Muck area.

Sample +56-06/170VE

Original Site Number: LL4


Location Loch Linnhe



Sample +56-06/171VE

Original Site Number: LL3


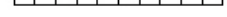
Location Loch Linnhe

BGS2007_7: +56-06/171VE		 British Geological Survey Natural Environmental Research Council			
Latitude: 56.6257°N	General Area: Loch Linnhe	Vessel: RRS James Cook			
Longitude: 05.40741°W	BGS Plan No: LL3	Station Keeping: DP			
Navigation: DGPS	Total Depth: 0m	Date: 10/5/07			
Equipment: Vibrocorer	Water Depth: 75m	Geologist: R. Gatliff			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0	0			Very irregular seabed with large boulders. Could not find suitable site.
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +56-06/172VE

Original Site Number: LL2

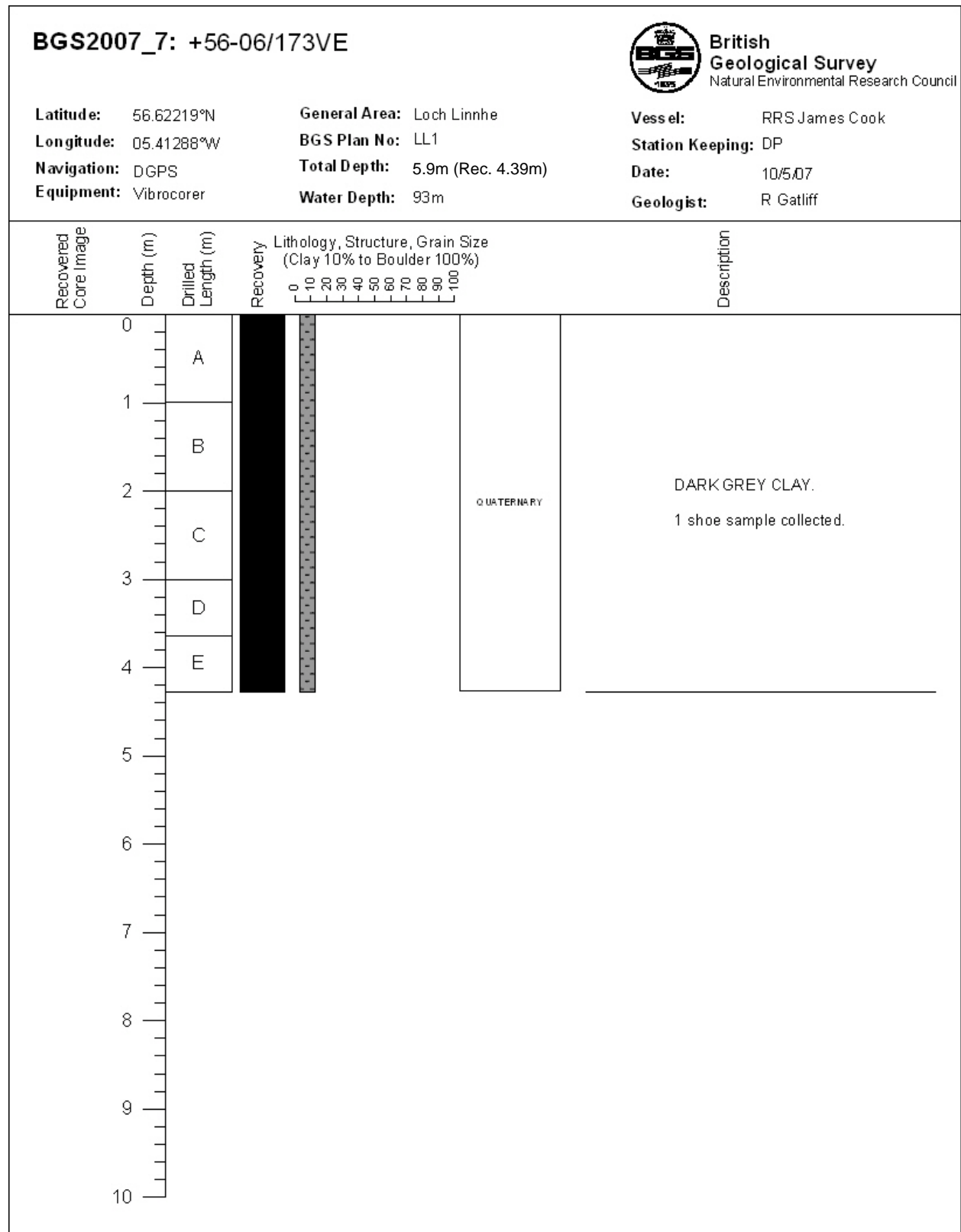
Location Loch Linnhe

BGS2007_7: +56-06/172VE		 British Geological Survey Natural Environmental Research Council			
Latitude: 56.6249°N	General Area: Loch Linnhe	Vessel: RRS James Cook			
Longitude: 05.40867°W	BGS Plan No: LL2	Station Keeping: DP			
Navigation: DGPS	Total Depth: 0m	Date: 10/5/07			
Equipment: Vibrocorer	Water Depth: 63m	Geologist: R. Gatliff			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				NO RECOVERY
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +56-06/173VE

Original Site Number: LL1

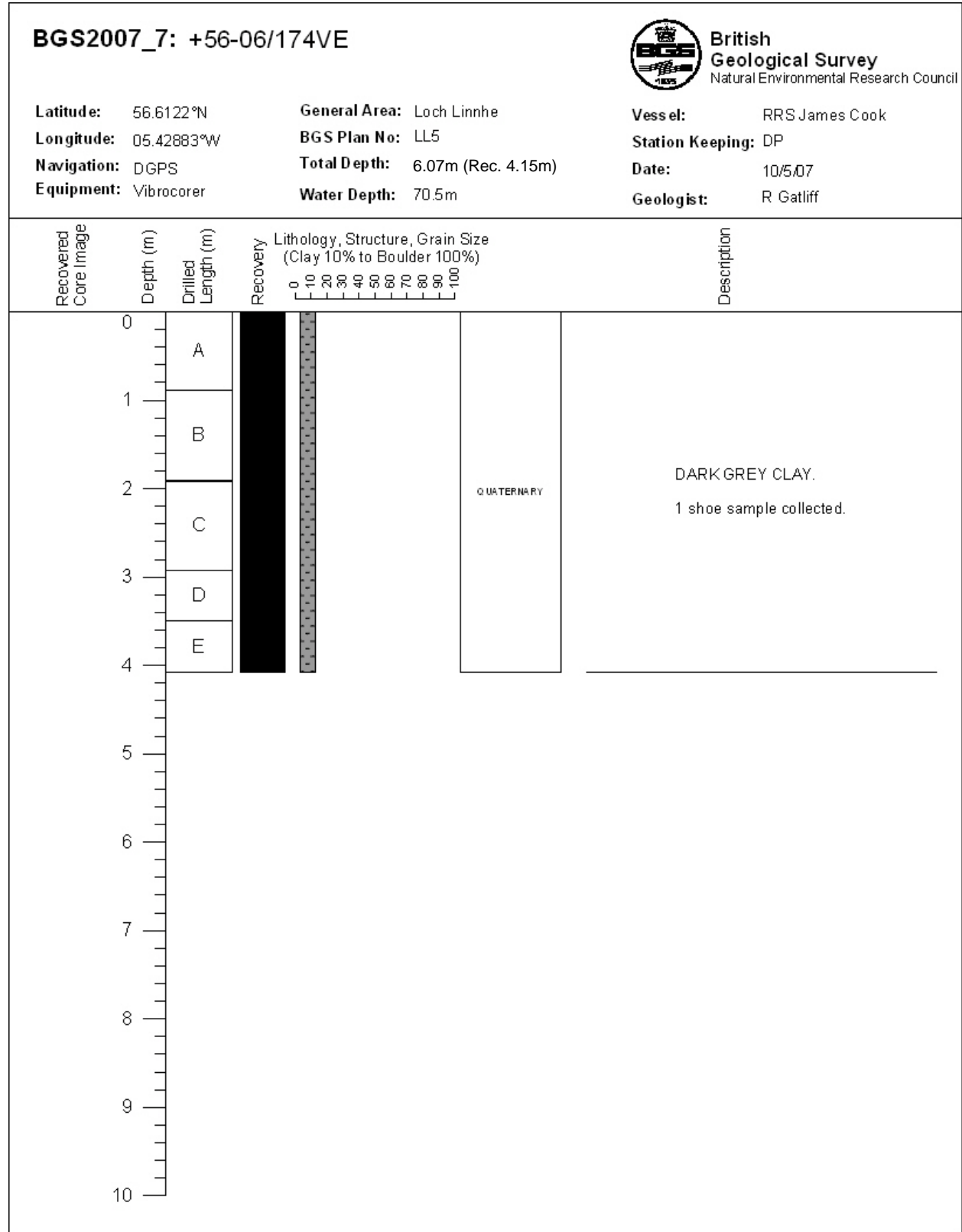
Location Loch Linnhe



Sample +56-06/174VE

Original Site Number: LL5

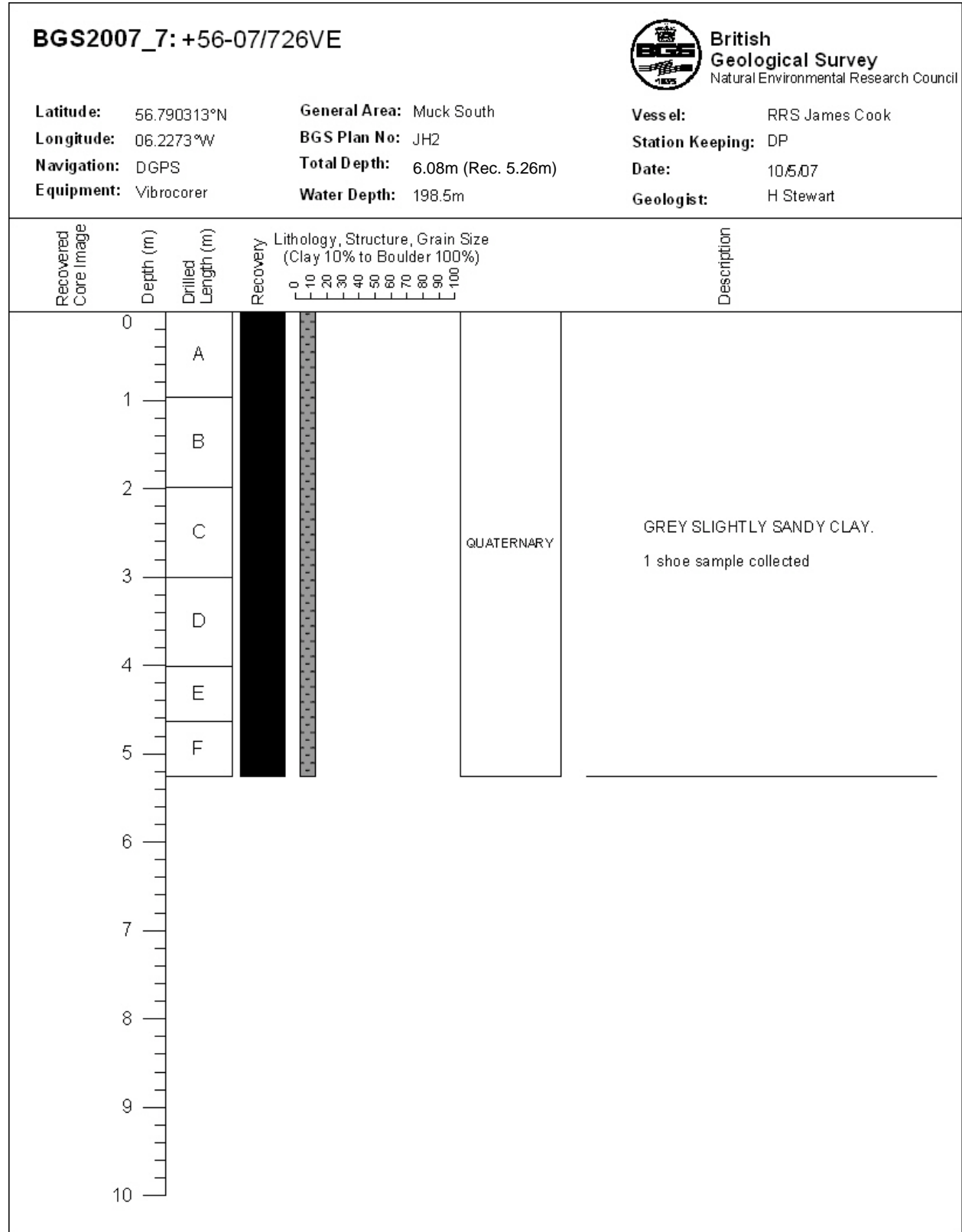
Location Loch Linnhe



Sample +56-07/726VE

Original Site Number: JH2

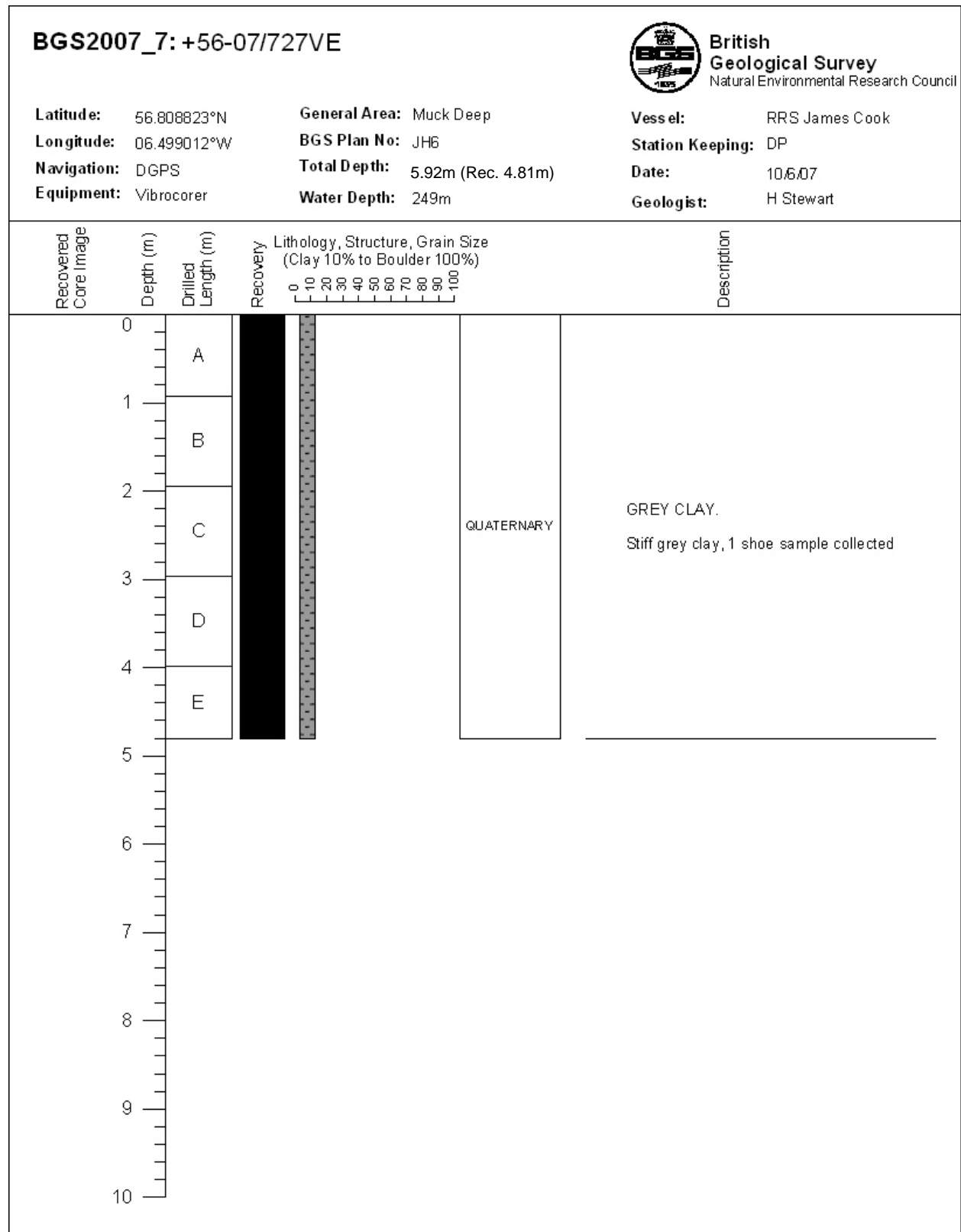
Location Muck South



Sample +56-07/727VE

Original Site Number: JH6

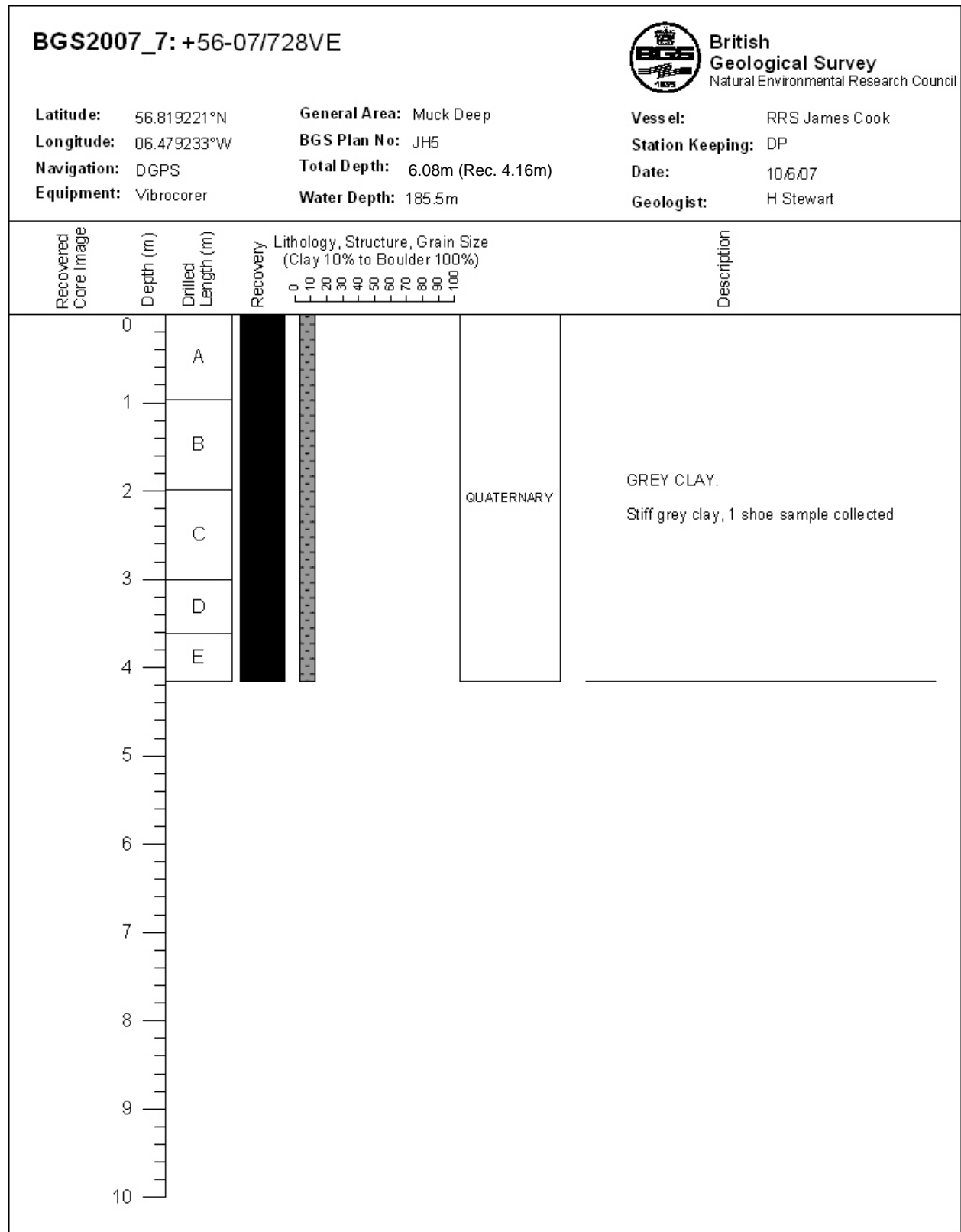
Location Muck Deep



Sample +56-07/728VE

Original Site Number: JH5

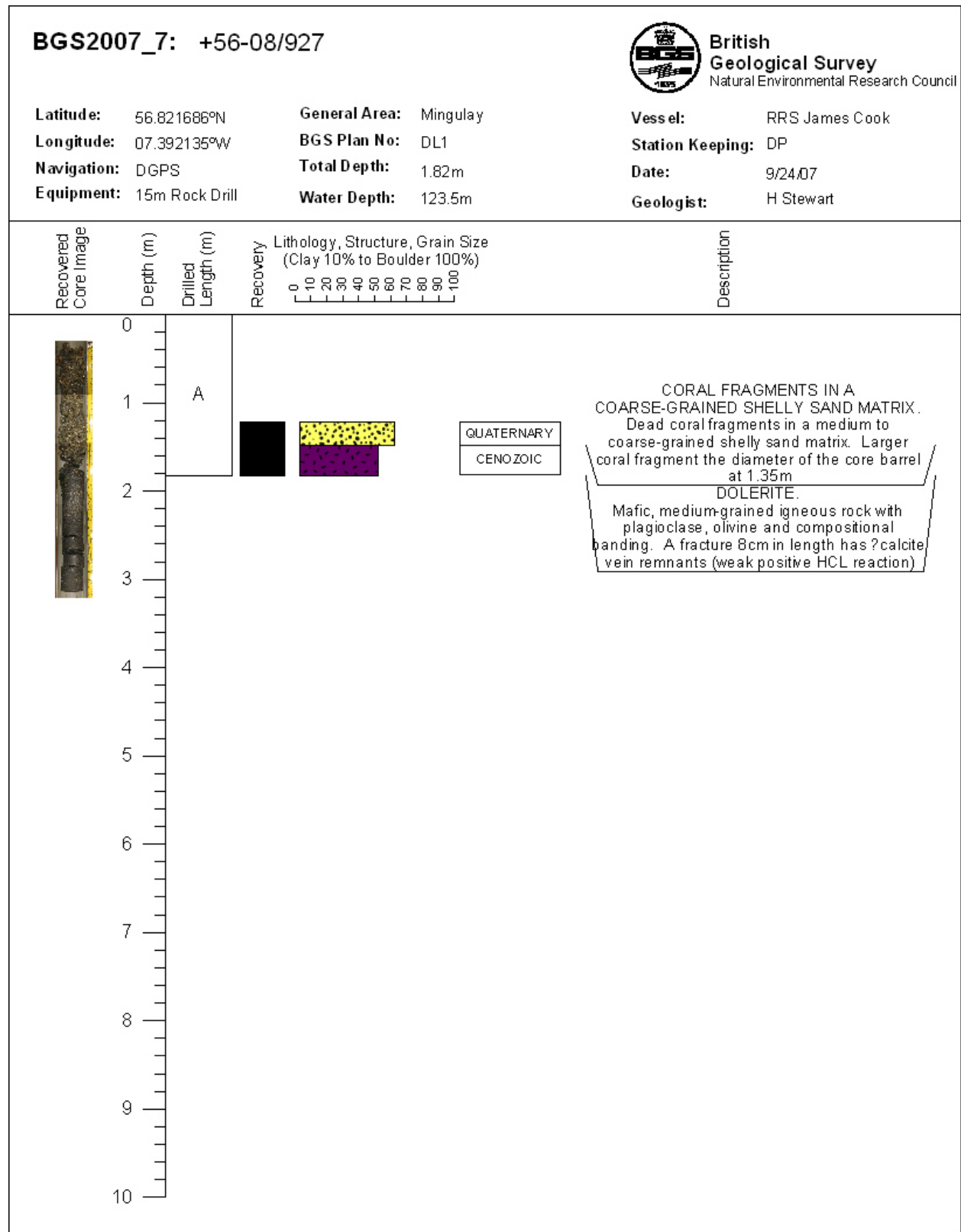
Location Muck Deep



Sample +56-08/927

Original Site Number: DL1

Location Mingulay



Sample +56-08/927


Core photograph



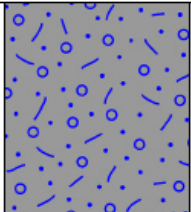


Sample +56-08/928

Original Site Number: DL10

Location Mingulay

BGS2007_7: +56-08/928		 British Geological Survey Natural Environmental Research Council	
Latitude: 56.78556°N	General Area: Mingulay	Vessel: RRS James Cook	
Longitude: 07.43009°W	BGS Plan No: DL10	Station Keeping: DP	
Navigation: DGPS	Total Depth: 1.83m	Date: 9/26/07	
Equipment: 15m Rock Drill	Water Depth: 135.5m	Geologist: H Stewart	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0 1 2 3 4 5 6 7 8 9 10	A			CENOZOIC CORAL FRAGMENTS IN A CLAY MATRIX. Fragments of dead coral in a fine grained olive grey clay matrix / infill (5Y 4/2). The largest recovered fragment was 6cm in length. 3 jar samples of the seabed from the rockdrill legs were collected along with 2 bag samples, one of coral from the seabed and the other of coral which fell out of core barrel 1

Sample +56-08/928


Core photograph




Sample +56-08/929

Original Site Number: DL11

Location Mingulay

BGS2007_7: +56-08/929		 British Geological Survey Natural Environmental Research Council	
Latitude: 56.821843°N	General Area: Mingulay	Vessel: RRS James Cook	
Longitude: 07.390719°W	BGS Plan No: DL11	Station Keeping: DP	
Navigation: DGPS	Total Depth: 0m	Date: 9/26/07	
Equipment: 15m Rock Drill	Water Depth: 120m	Geologist: R Gatliff	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0			CENOZOIC	<p>CORAL FRAGMENTS IN A FINE-GRAINED MUD/CLAY MATRIX.</p> <p>No core recovered, sea-bed sample comprises dead ?<i>Lophelia pertusa</i> in a fine-grained mud/clay matrix. The fragments range in size from 1-3cm to over 30cm.</p>
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +56-08/929

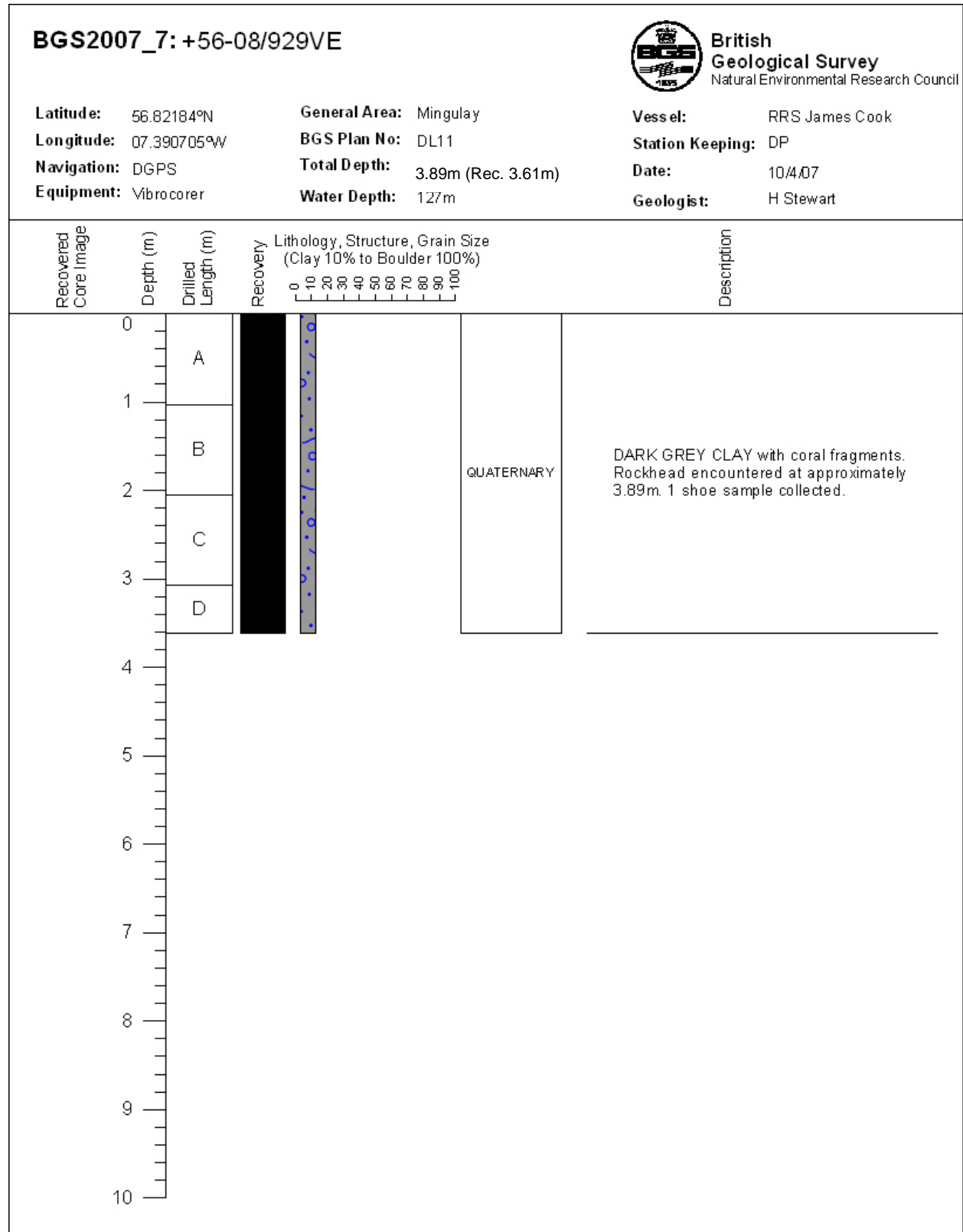
Core photograph



Sample +56-08/929VE

Original Site Number: DL11

Location Mingulay



British Geological Survey
Natural Environmental Research Council

BGS2007_7: +56-08/929VE


Latitude: 56.82184°N
Longitude: 07.390705°W
Navigation: DGPS
Equipment: Vibrocorer
General Area: Mingulay
BGS Plan No: DL11
Total Depth: 3.89m (Rec. 3.61m)
Water Depth: 127m

Vessel: RRS James Cook
Station Keeping: DP
Date: 10/4/07
Geologist: H Stewart

Sample +56-08/930VE

Original Site Number: DL13


Location Mingulay

BGS2007_7: +56-08/930VE		 British Geological Survey Natural Environmental Research Council			
Latitude: 56.8221°N	General Area: Mingulay	Vessel: RRS James Cook			
Longitude: 07.396483°W	BGS Plan No: DL13	Station Keeping: DP			
Navigation: DGPS	Total Depth: 5.98m (Rec. 5.25m)	Date: 10/4/07			
Equipment: Vibrocorer	Water Depth: 134m	Geologist: H Stewart			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0	A			
	1	B			
	2	C			
	3	D			
	4	E			
	5	F			
	6				
	7				
	8				
	9				
	10				
				QUATERNARY	DARK GREY CLAY with coral fragments. 1 shoe sample collected.

Sample +56-08/931VE

Original Site Number: DL14

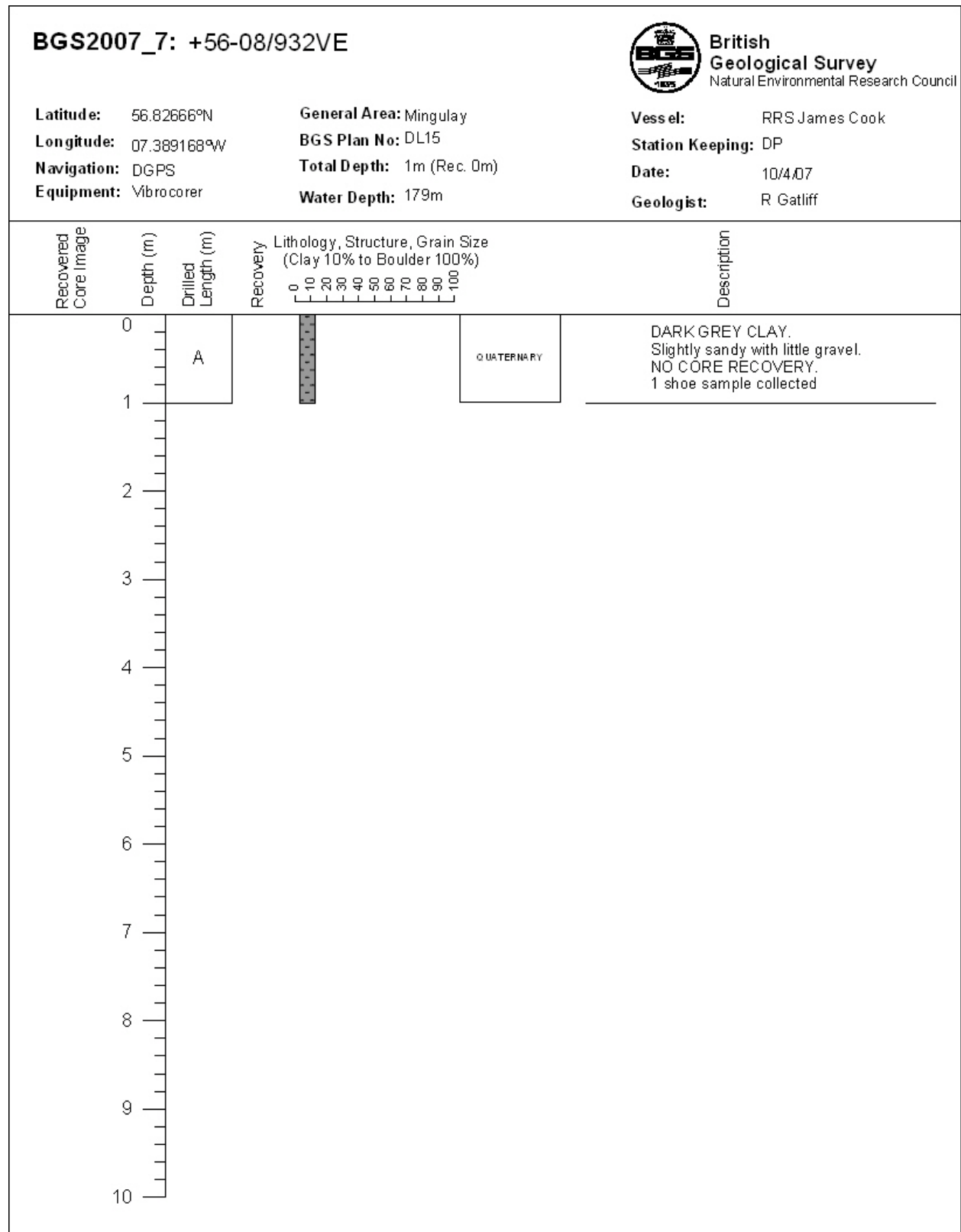
Location Mingulay

BGS2007_7: +56-08/931VE		 British Geological Survey Natural Environmental Research Council			
Latitude: 56.819995°N	General Area: Mingulay	Vessel: RRS James Cook			
Longitude: 07.393308°W	BGS Plan No: DL14	Station Keeping: DP			
Navigation: DGPS	Total Depth: 0m	Date: 10/4/07			
Equipment: Vibrocorer	Water Depth: 120m	Geologist: R Gatliff			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				Could not land on sea bed due either to live coral or slope
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +56-08/932VE

Original Site Number: DL15

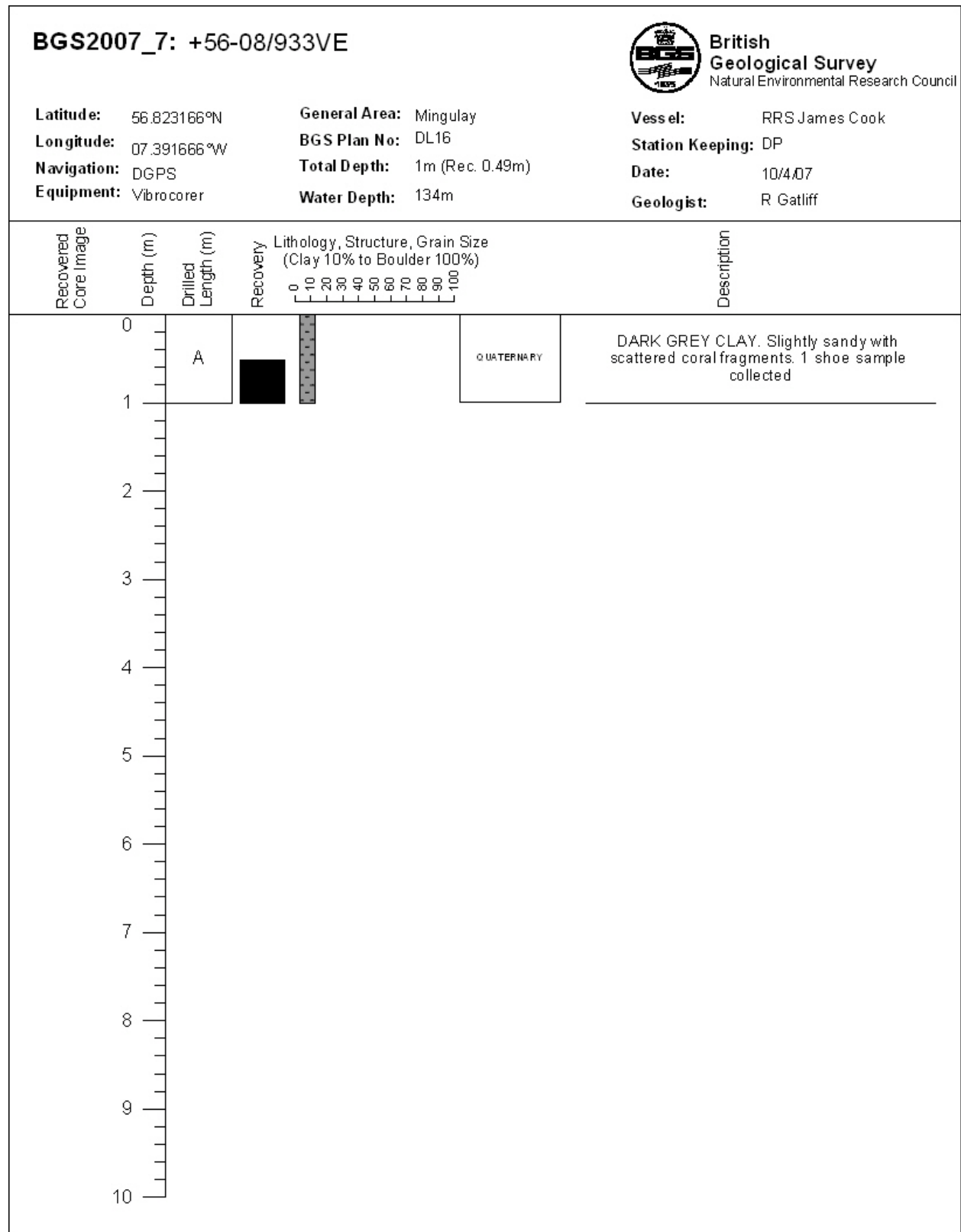
Location Mingulay



Sample +56-08/933VE

Original Site Number: DL16


Location Mingulay



Sample +56-08/934VE

Original Site Number: DL12


Location Mingulay

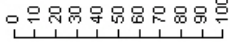
BGS2007_7: +56-08/934VE		 British Geological Survey Natural Environmental Research Council			
Latitude: 56.82222°N	General Area: Mingulay	Vessel: RRS James Cook			
Longitude: 07.395953°W	BGS Plan No: DL12	Station Keeping: DP			
Navigation: DGPS	Total Depth: 0m	Date: 10/4/07			
Equipment: Vibrocorer	Water Depth: 139m	Geologist: H Stewart			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				Could not land on sea bed due either to live coral or slope
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +56-08/935VE

Original Site Number: DL17

Location Mingulay

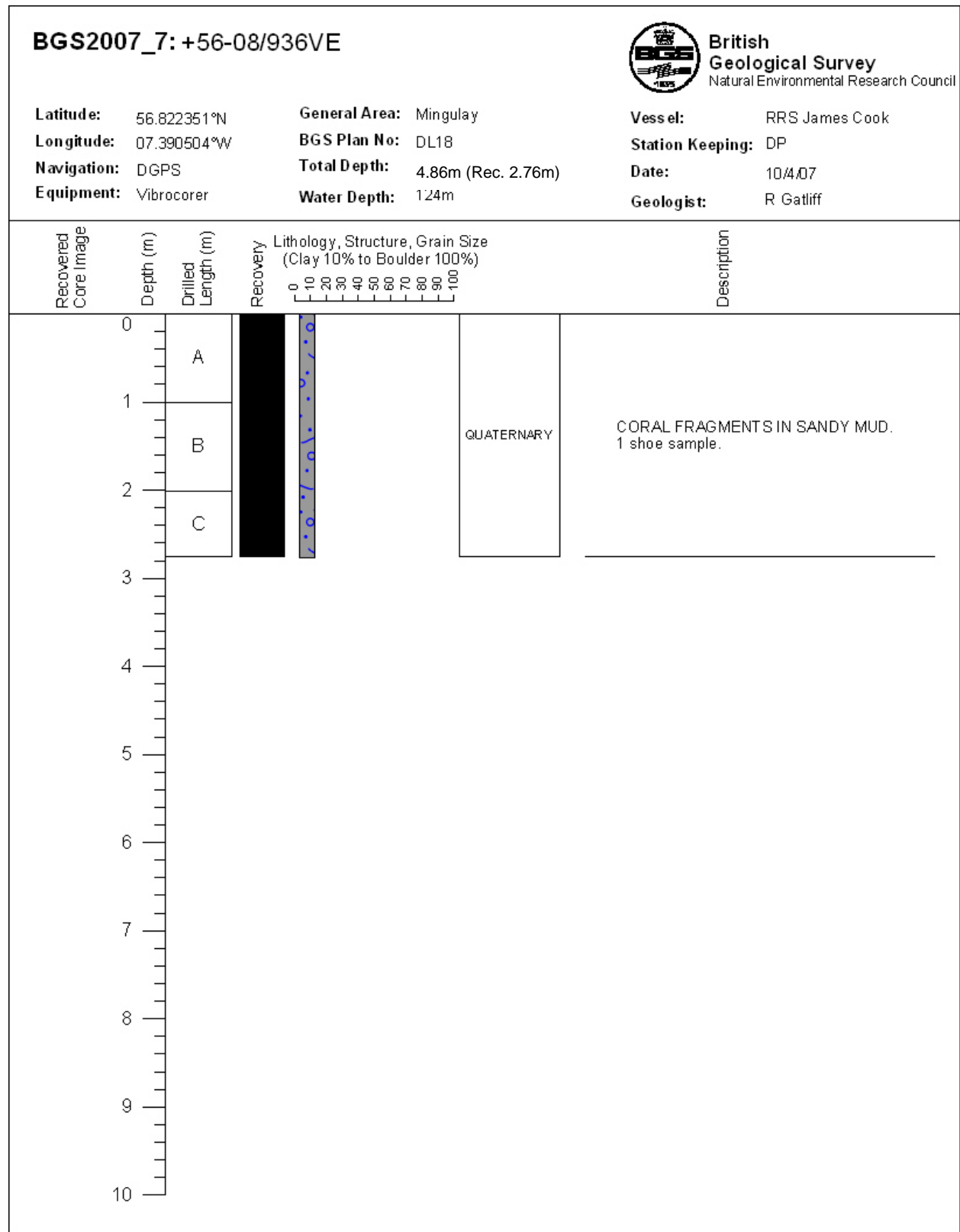
BGS2007_7: +56-08/935VE		 British Geological Survey Natural Environmental Research Council	
Latitude:	56.820816°N	General Area:	Mingulay
Longitude:	07.3906°W	BGS Plan No:	DL17
Navigation:	DGPS	Total Depth:	0m
Equipment:	Vibrocorer	Water Depth:	129.5m
		Vessel:	RRS James Cook
		Station Keeping:	DP
		Date:	10/4/07
		Geologist:	R Gatliff

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				NO RECOVERY
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +56-08/936VE

Original Site Number: DL18

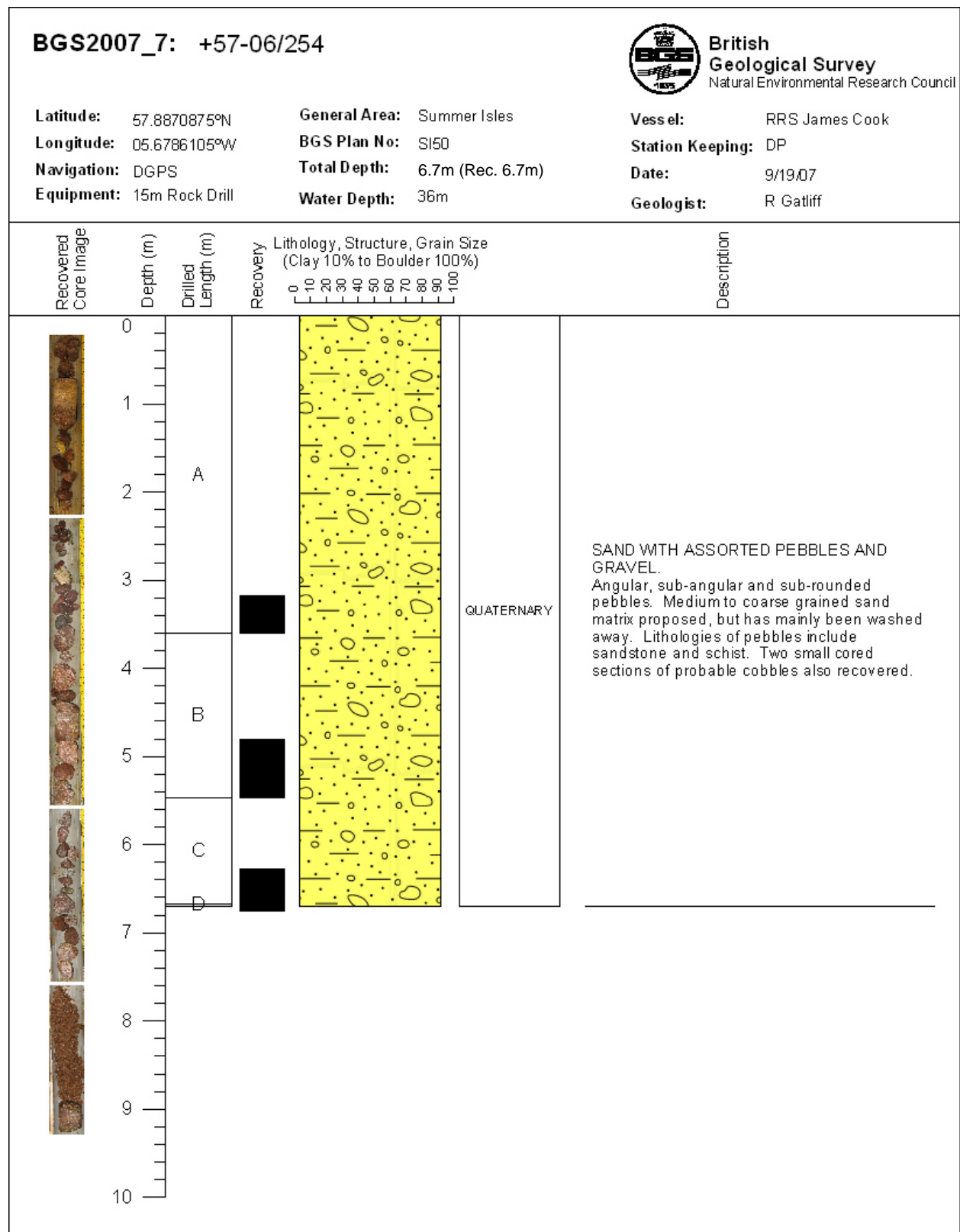
Location Mingulay



Sample +57-06/254

Original Site Number: SI50

Location Summer Isles, Outer Loch Ewe



Sample +57-06/254

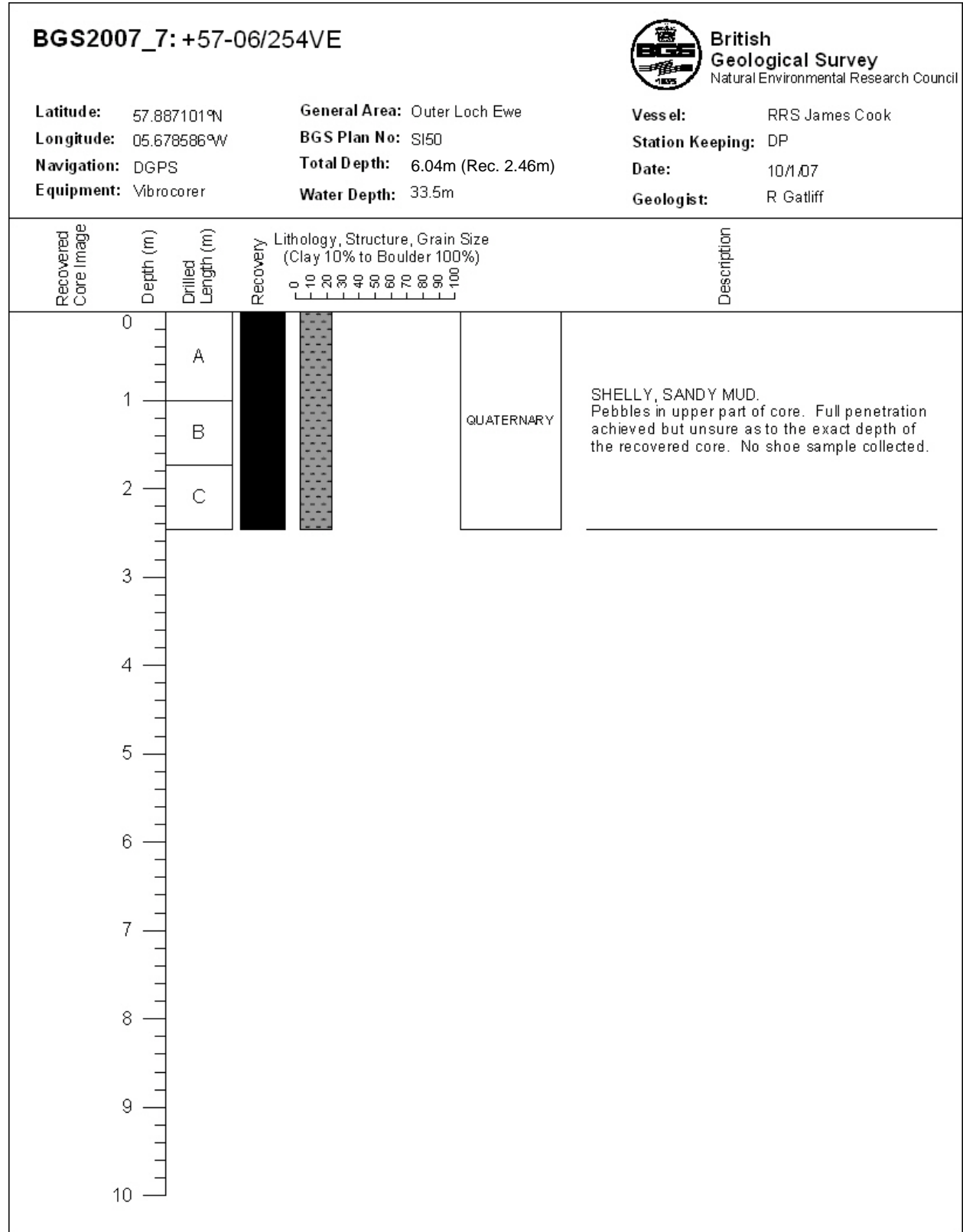
Core photograph



Sample +57-06/254VE

Original Site Number: SI50

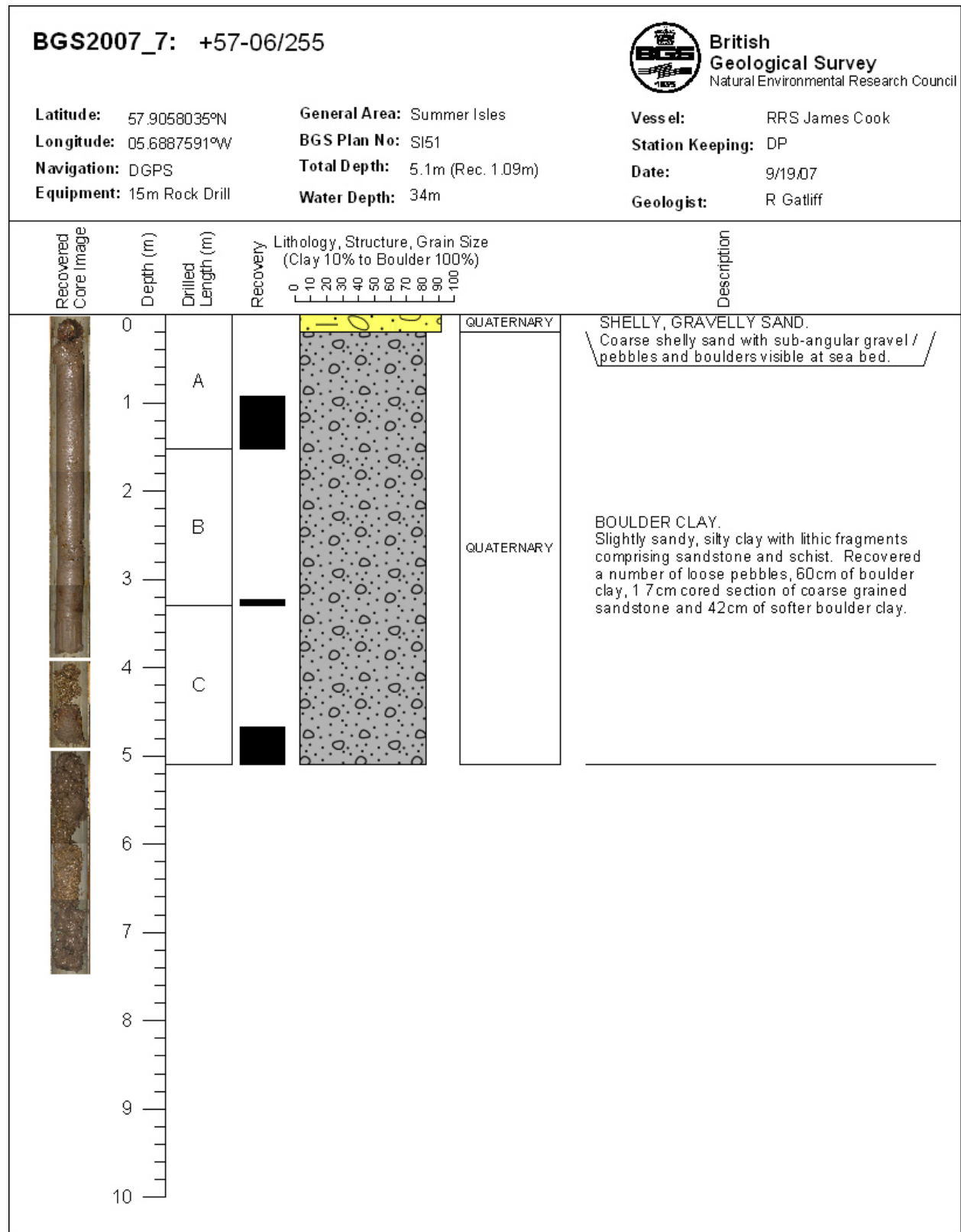
Location Summer Isles, Outer Loch Ewe



Sample +57-06/255

Original Site Number: SI51

Location Summer Isles, Loch Ewe



Sample +57-06/255

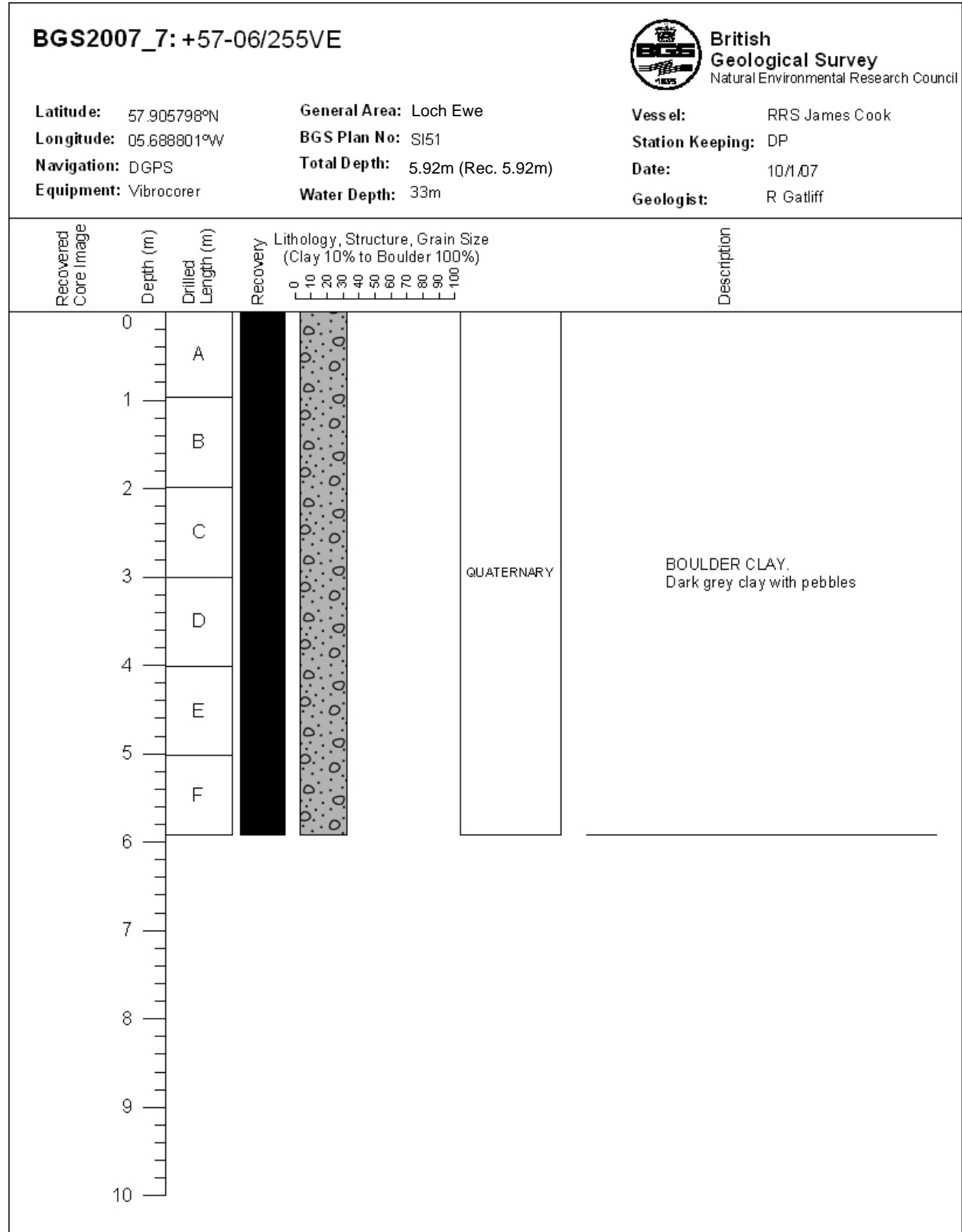
Core photograph



Sample +57-06/255VE

Original Site Number: SI51

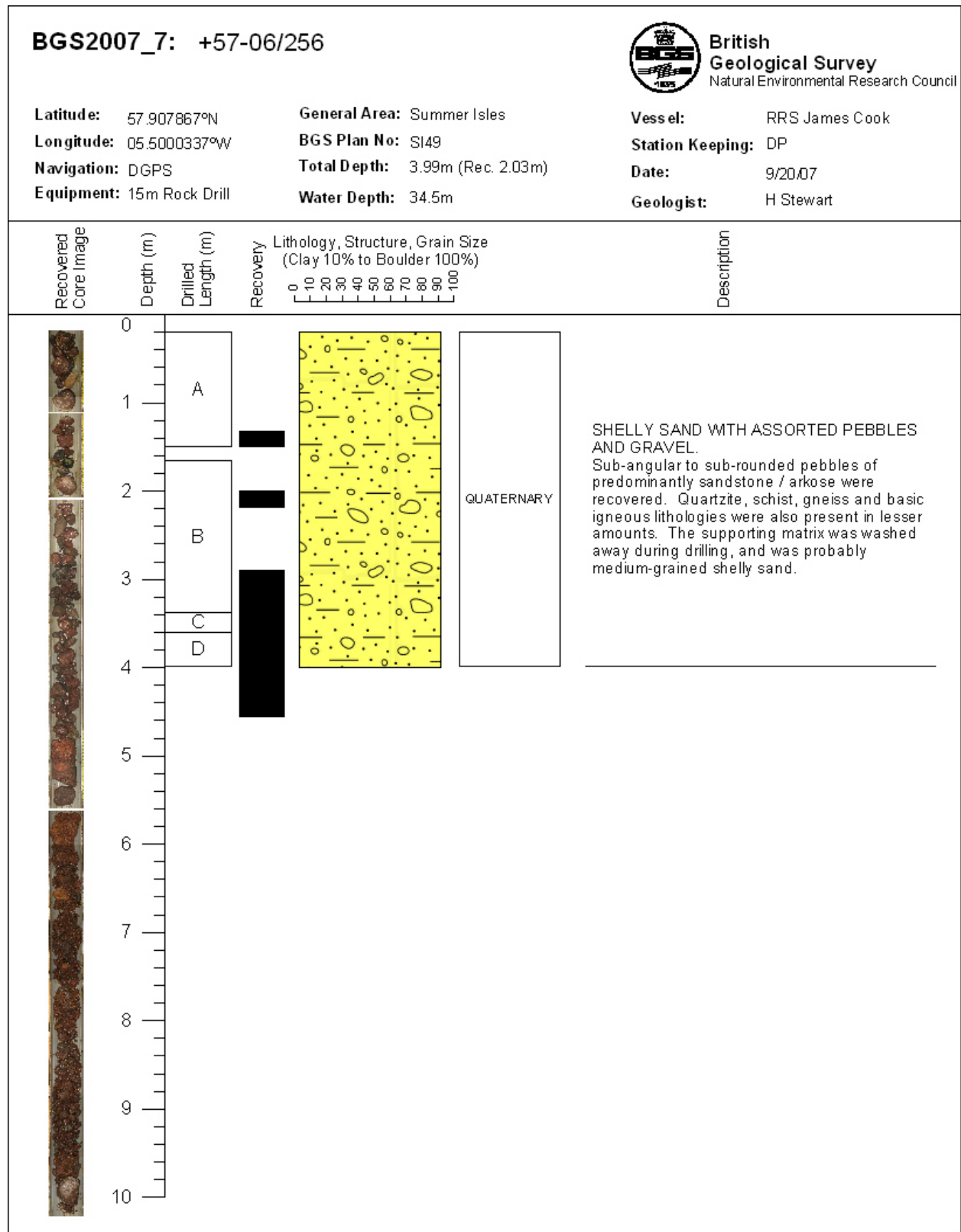
Location Summer Isles, Loch Ewe



Sample +57-06/256

Original Site Number: SI49

Location Summer Isles, Gruinard Bay



Sample +57-06/256

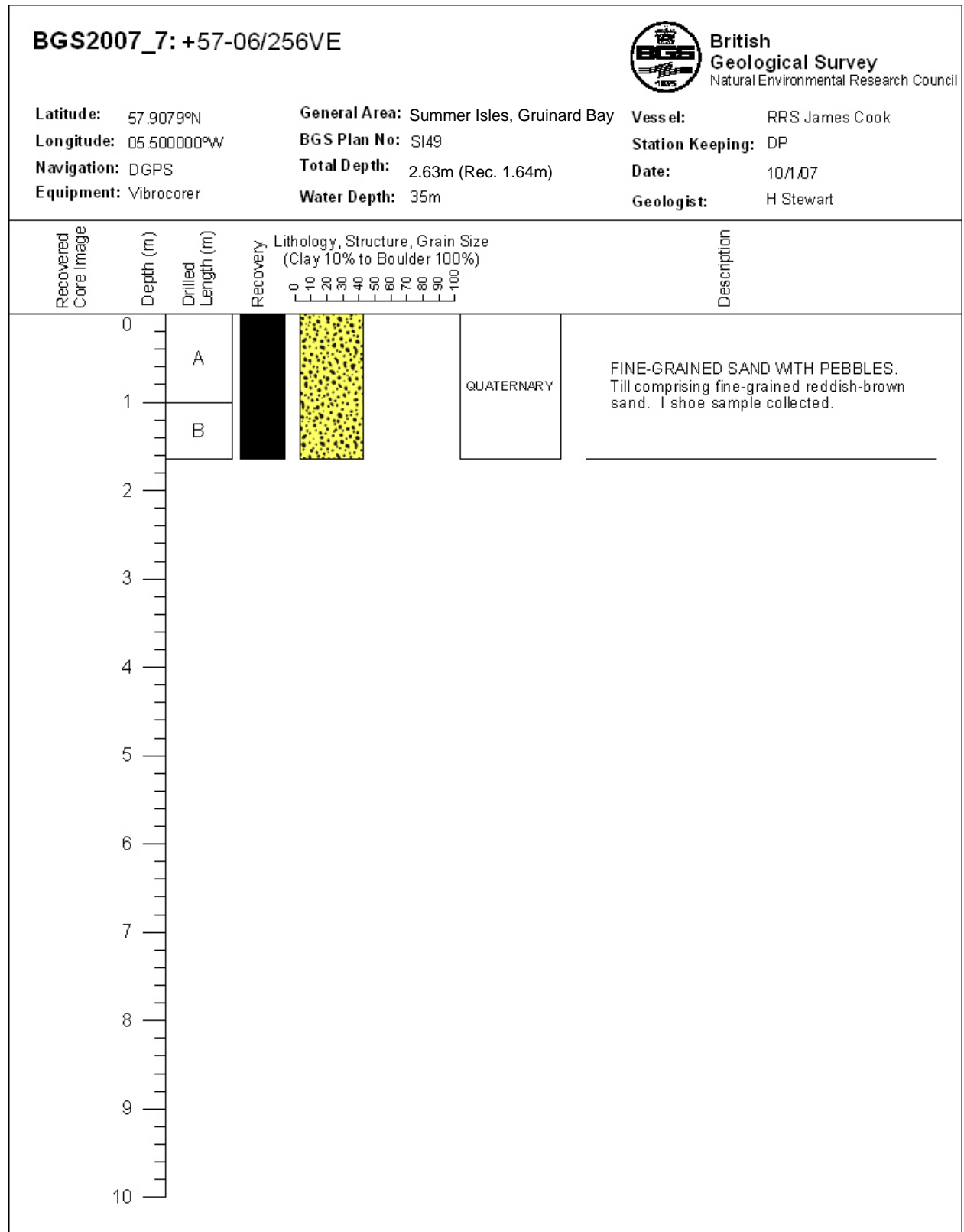
Core photograph



Sample +57-06/256VE

Original Site Number: SI49

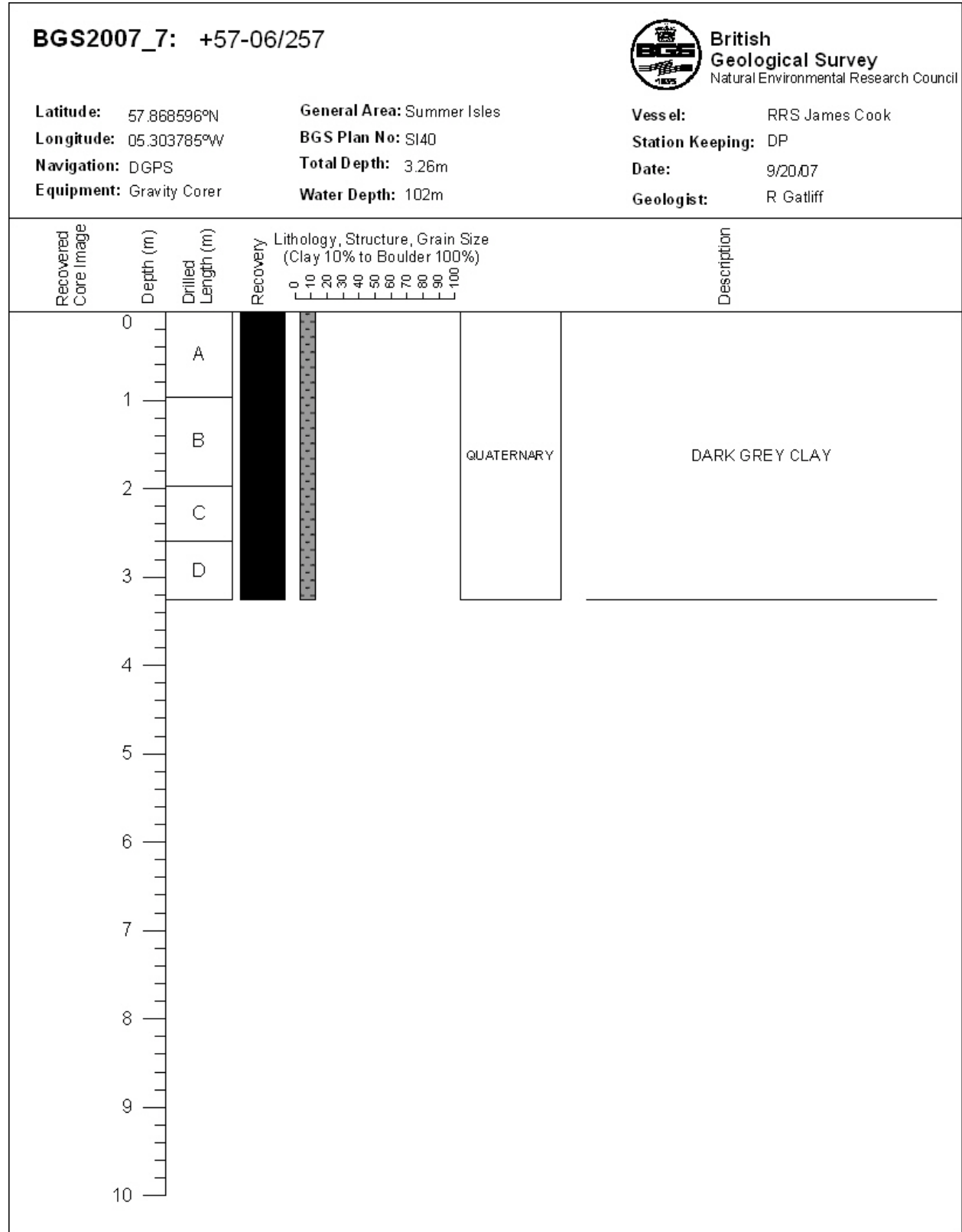
Location Summer Isles, Gruinard Bay



Sample +57-06/257CS

Original Site Number: SI40

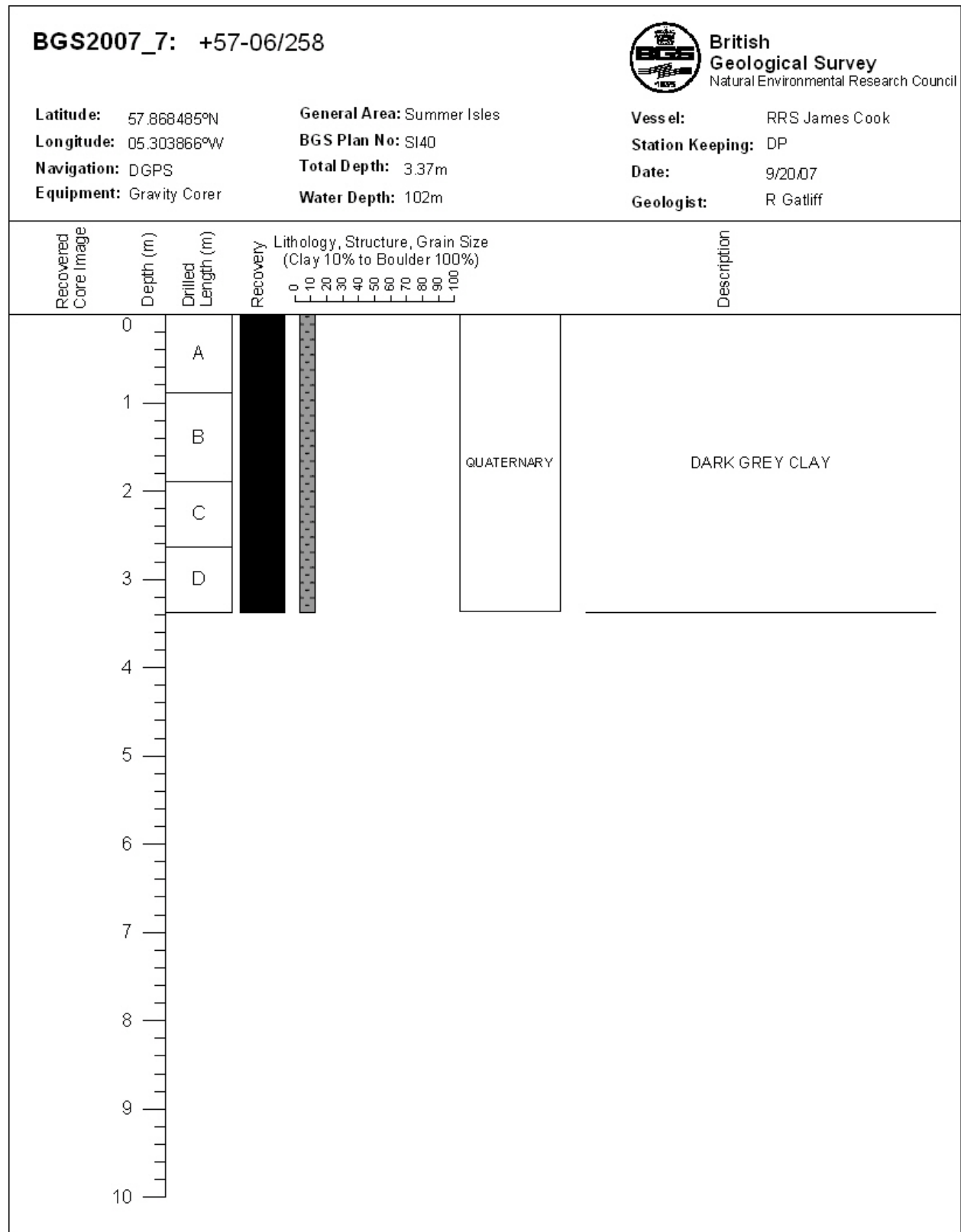
Location Summer Isles



Sample +57-06/258CS

Original Site Number: SI40

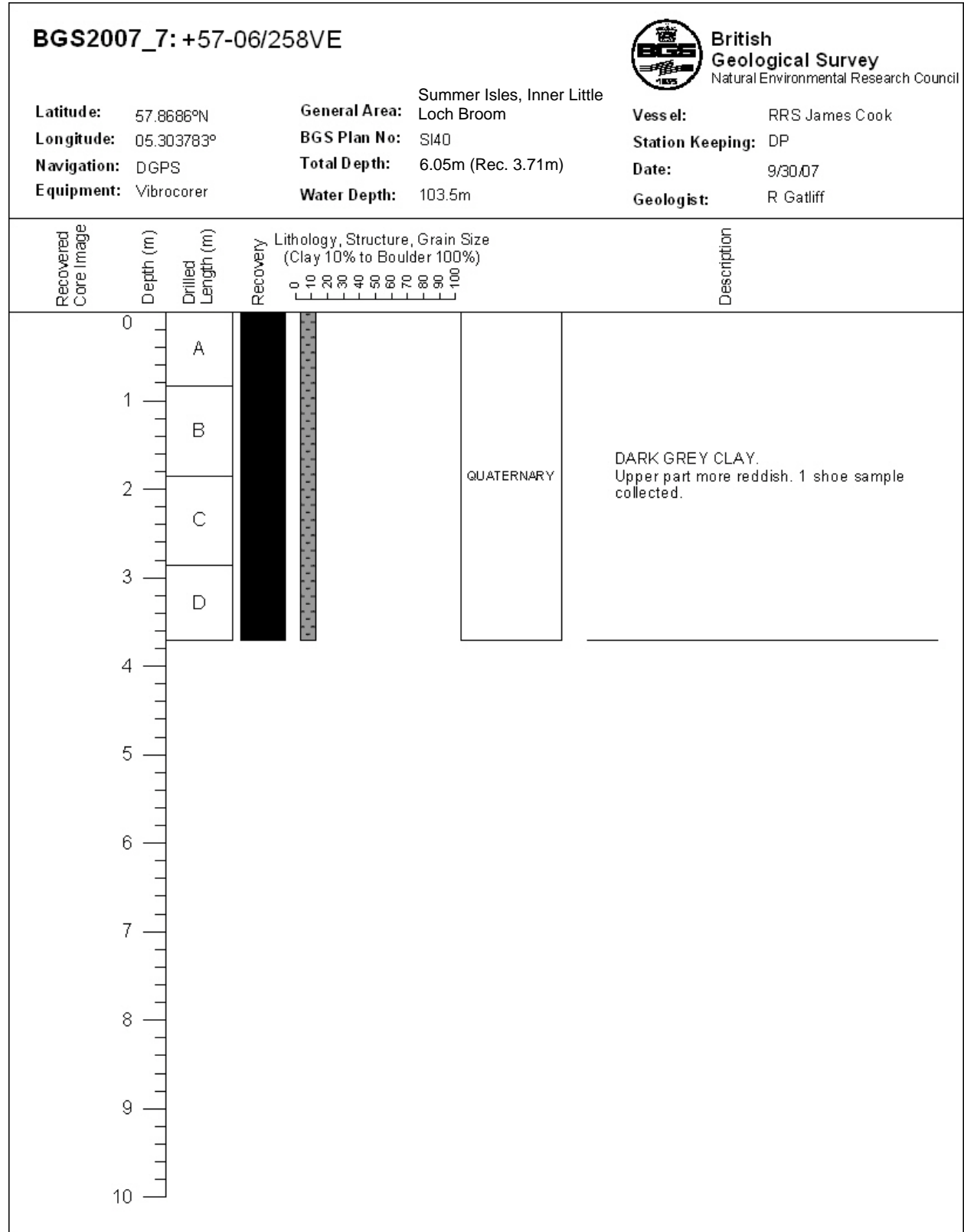
Location Summer Isles



Sample +57-06/258VE

Original Site Number: SI40

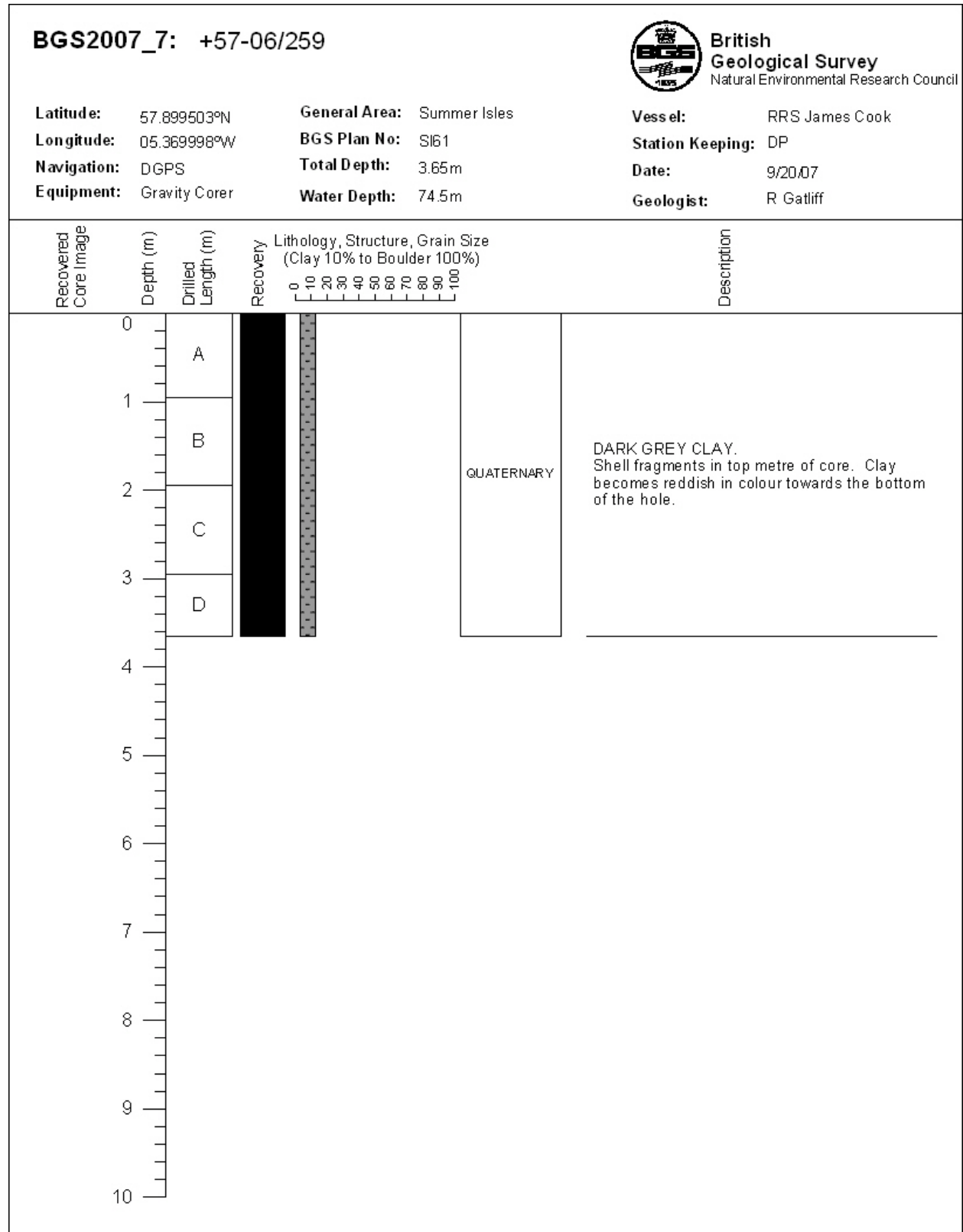
Location Summer Isles, Inner Little Loch Broom



Sample +57-06/259CS

Original Site Number: SI61

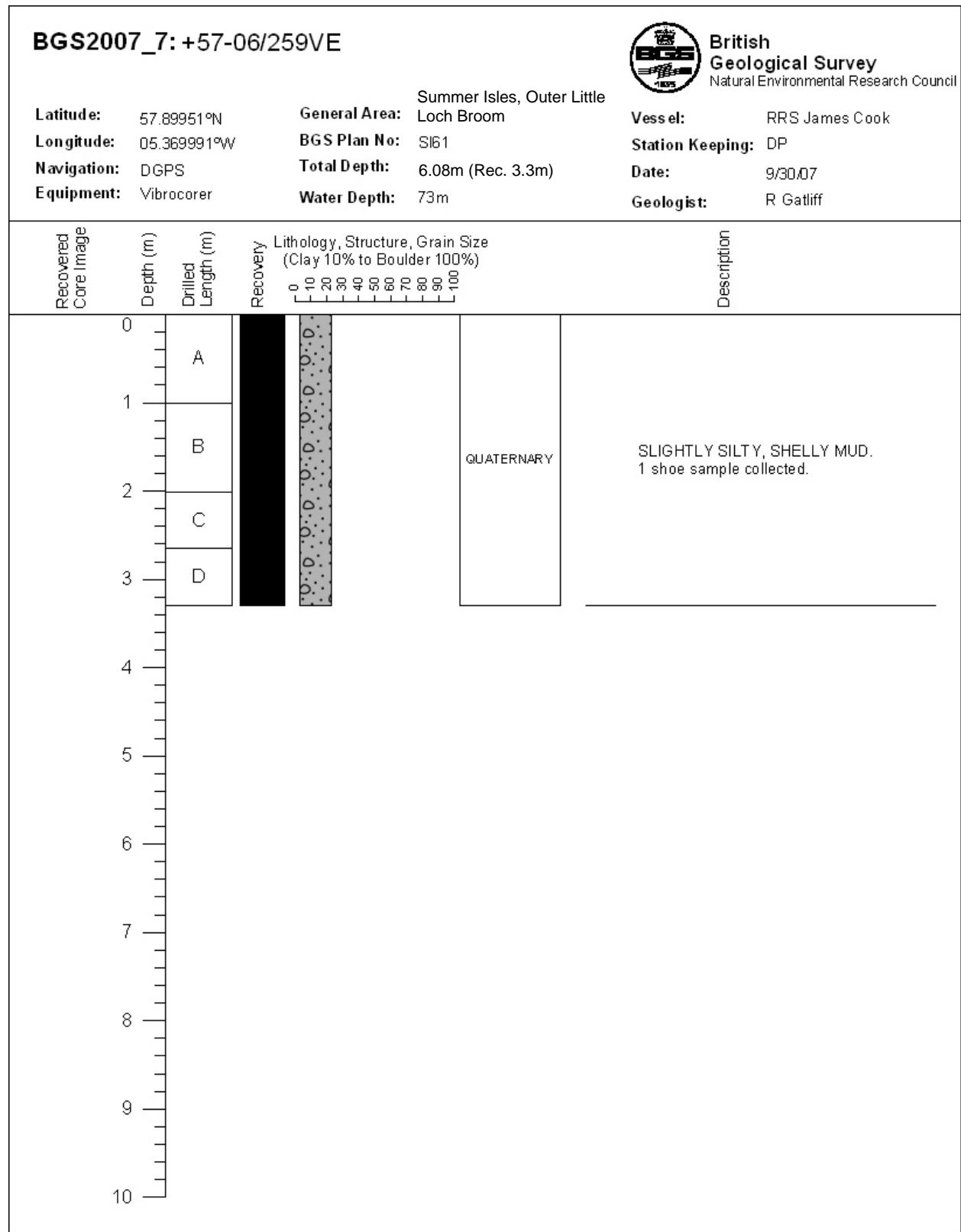
Location Summer Isles



Sample +57-06/259VE

Original Site Number: SI61

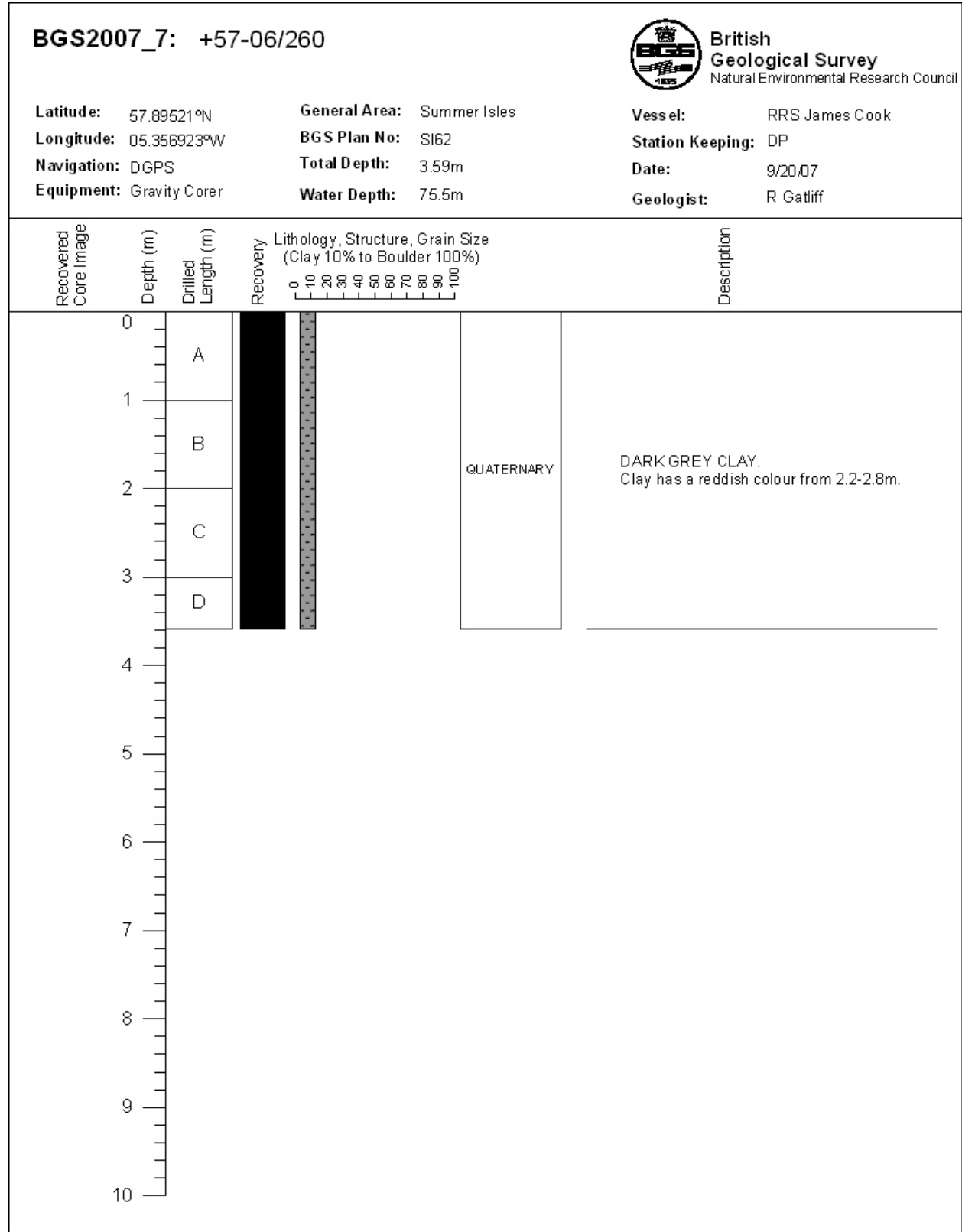
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/260CS

Original Site Number: SI62

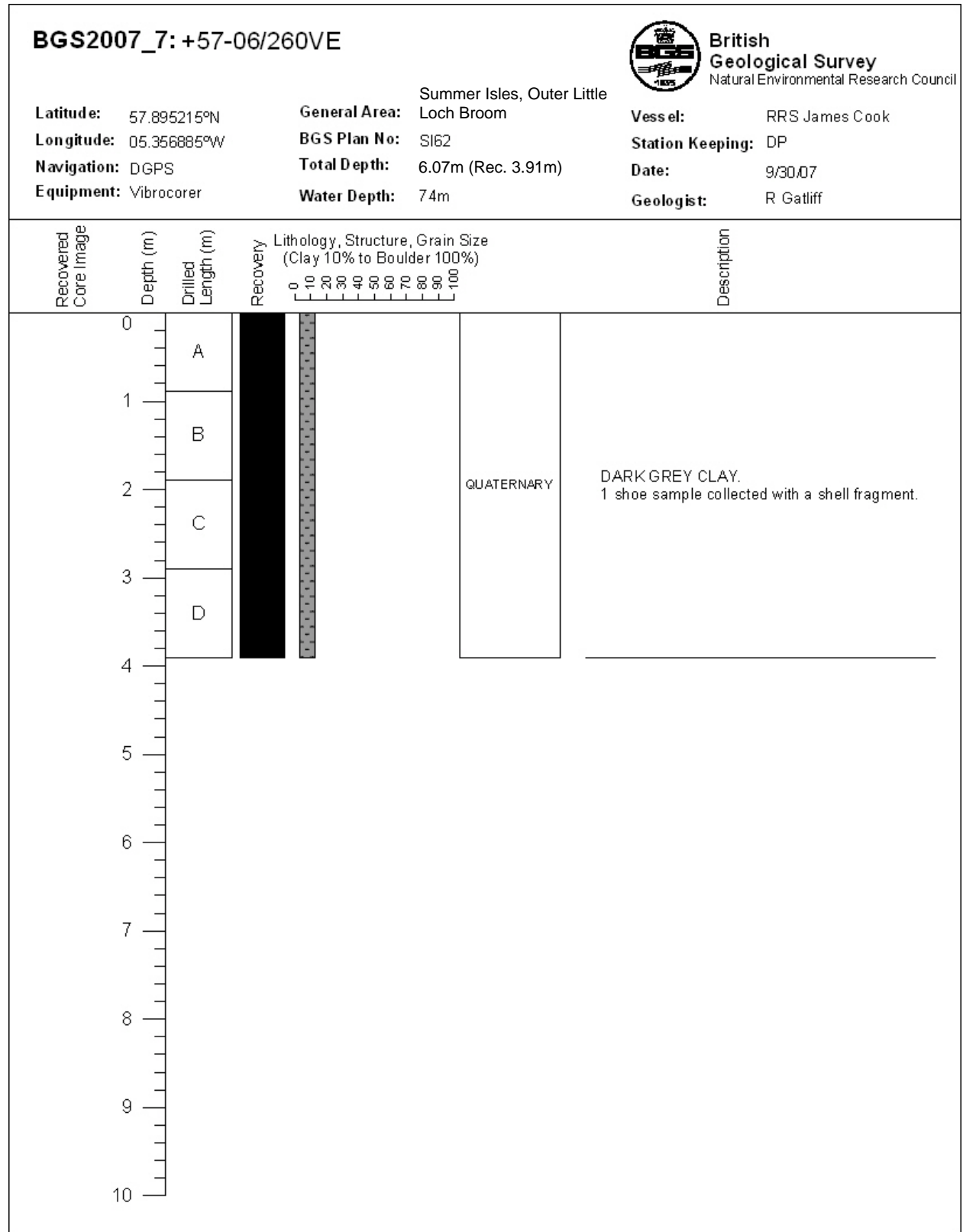
Location Summer Isles



Sample +57-06/260VE

Original Site Number: SI62


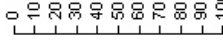
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/261CS

Original Site Number: SI63

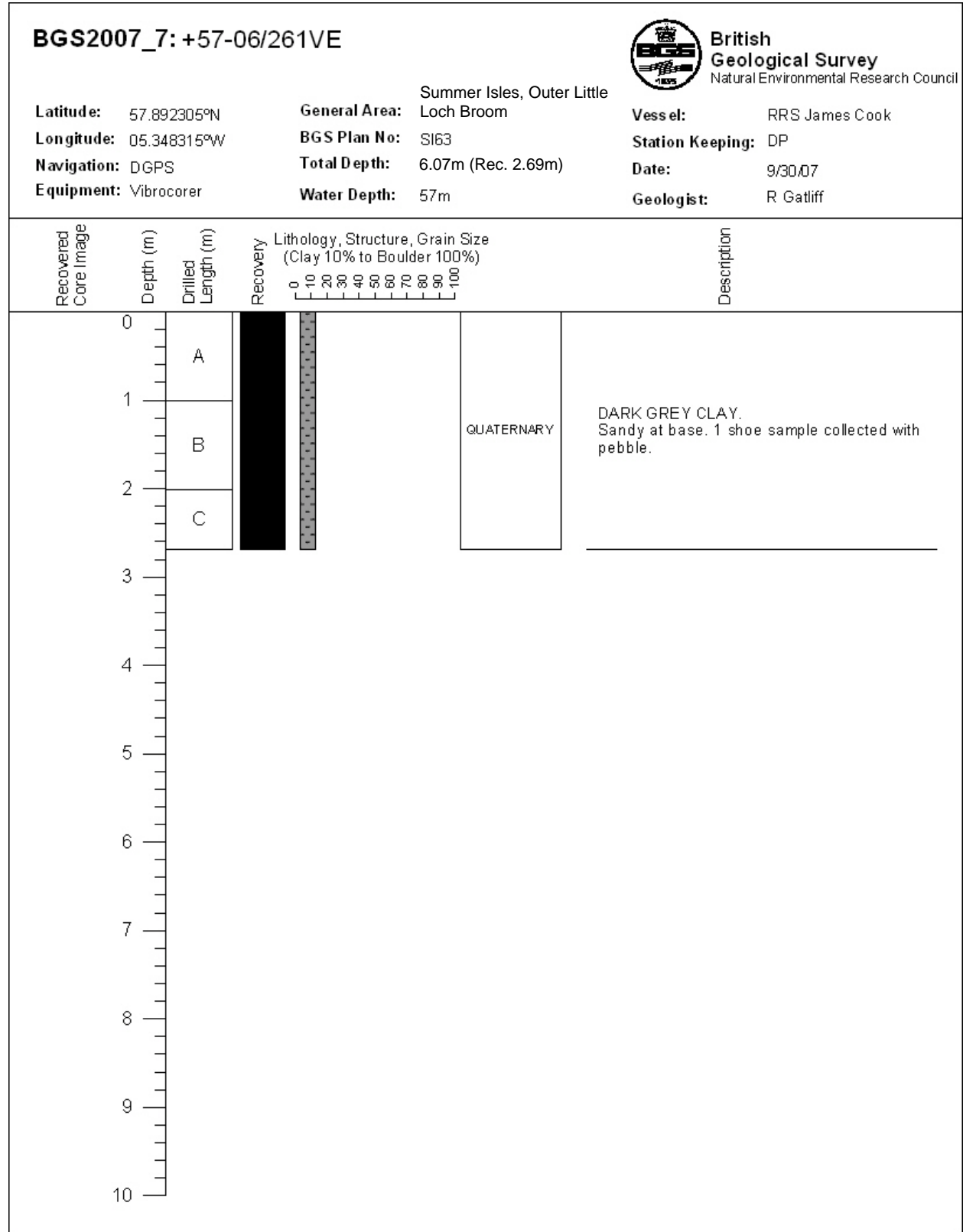
Location Summer Isles, Outer Little Loch Broom

BGS2007_7: +57-06/261		 British Geological Survey Natural Environmental Research Council		
Latitude: 57.89231°N	General Area: Summer Isles, Outer Little Loch Broom	Vessel: RRS James Cook		
Longitude: 05.348316°W	BGS Plan No: SI63	Station Keeping: DP		
Navigation: DGPS	Total Depth: 0m	Date: 9/20/07		
Equipment: Gravity Corer	Water Depth: 0m	Geologist: R Gatliff		
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery Lithology, Structure, Grain Size (Clay 10% to Boulder 100%) 	Description
	0			NO RECOVERY
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			

Sample +57-06/261VE

Original Site Number: SI63

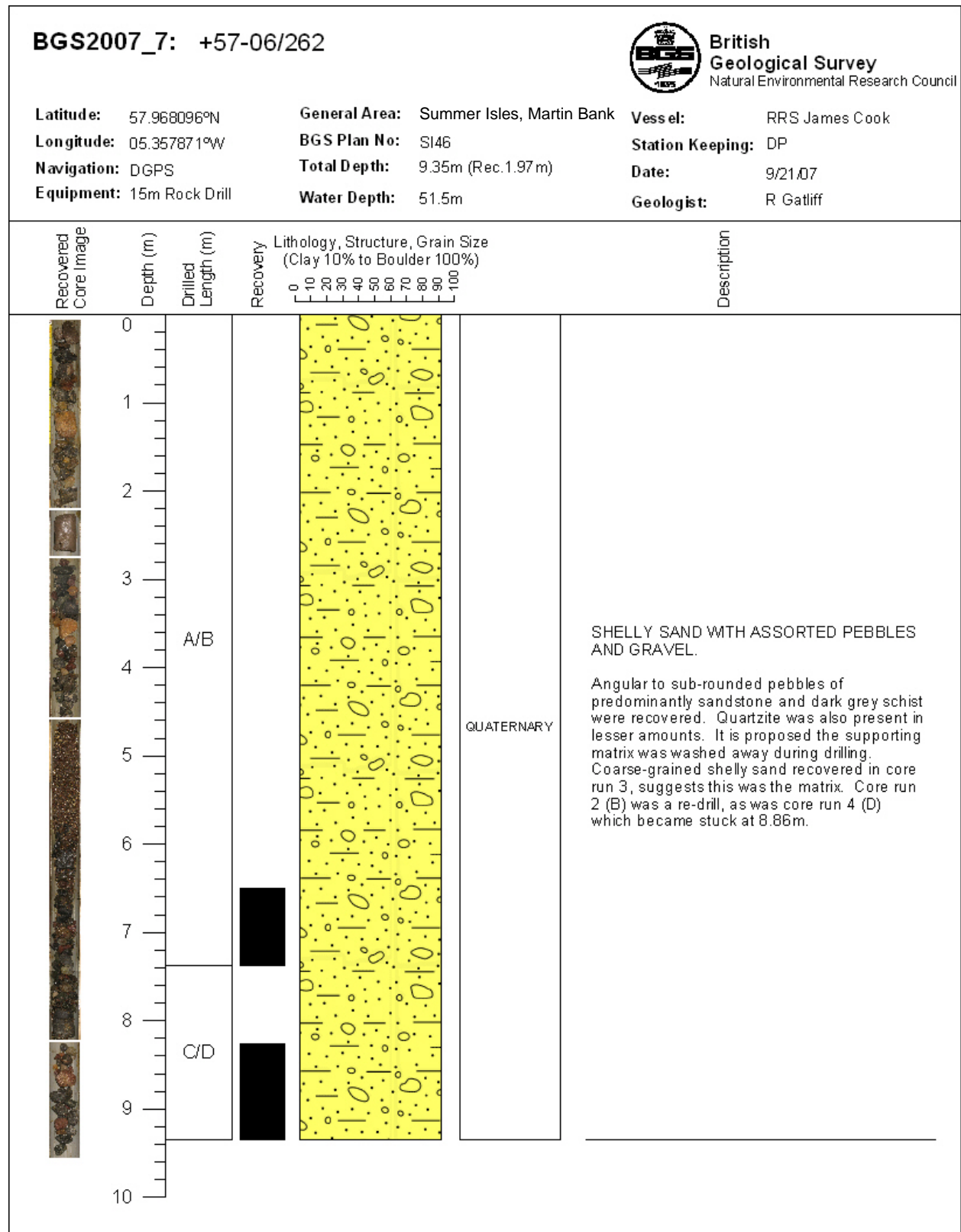
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/262

Original Site Number: SI46

Location Summer Isles, Martin Bank



Sample +57-06/262

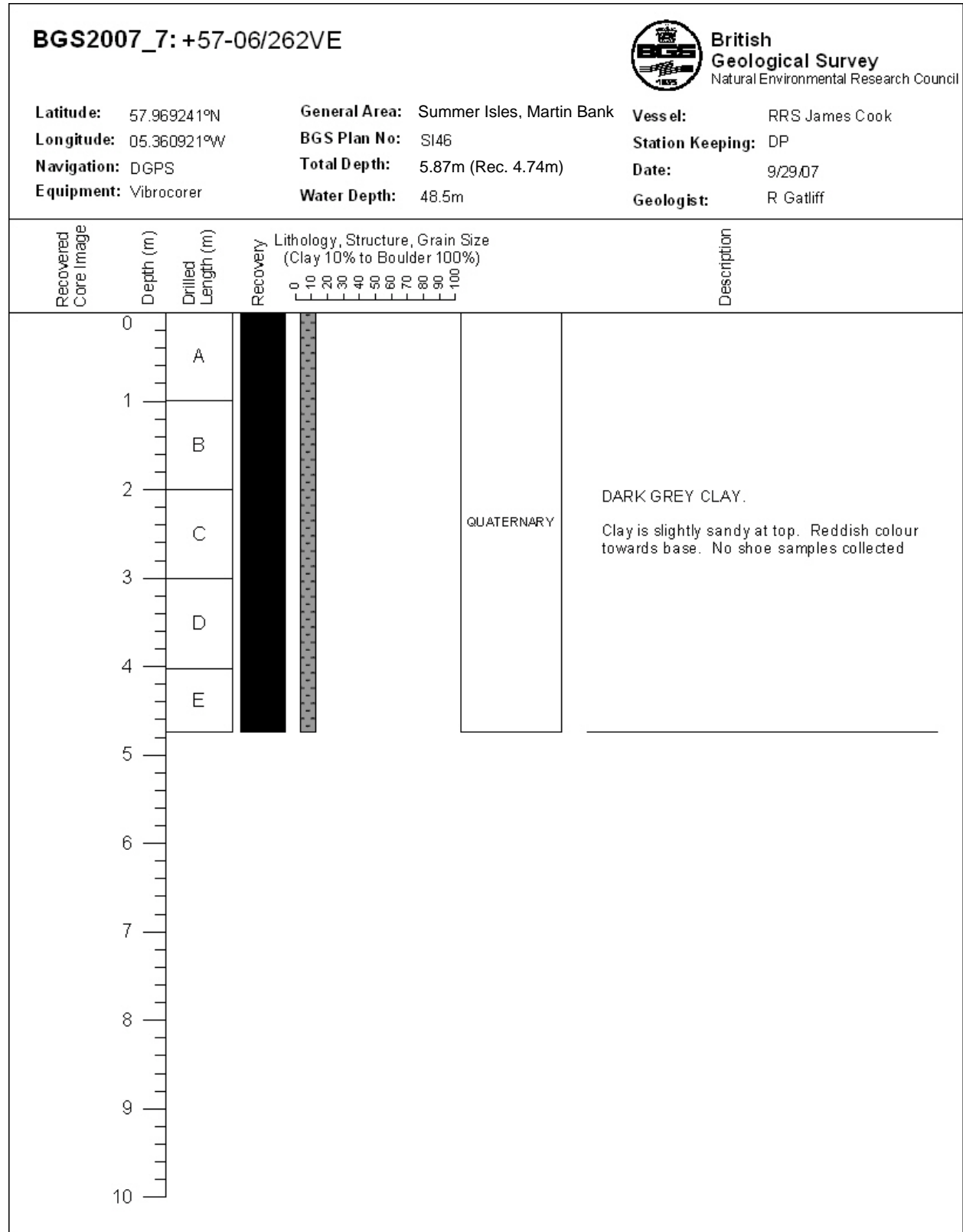
Core photograph



Sample +57-06/262VE

Original Site Number: SI46

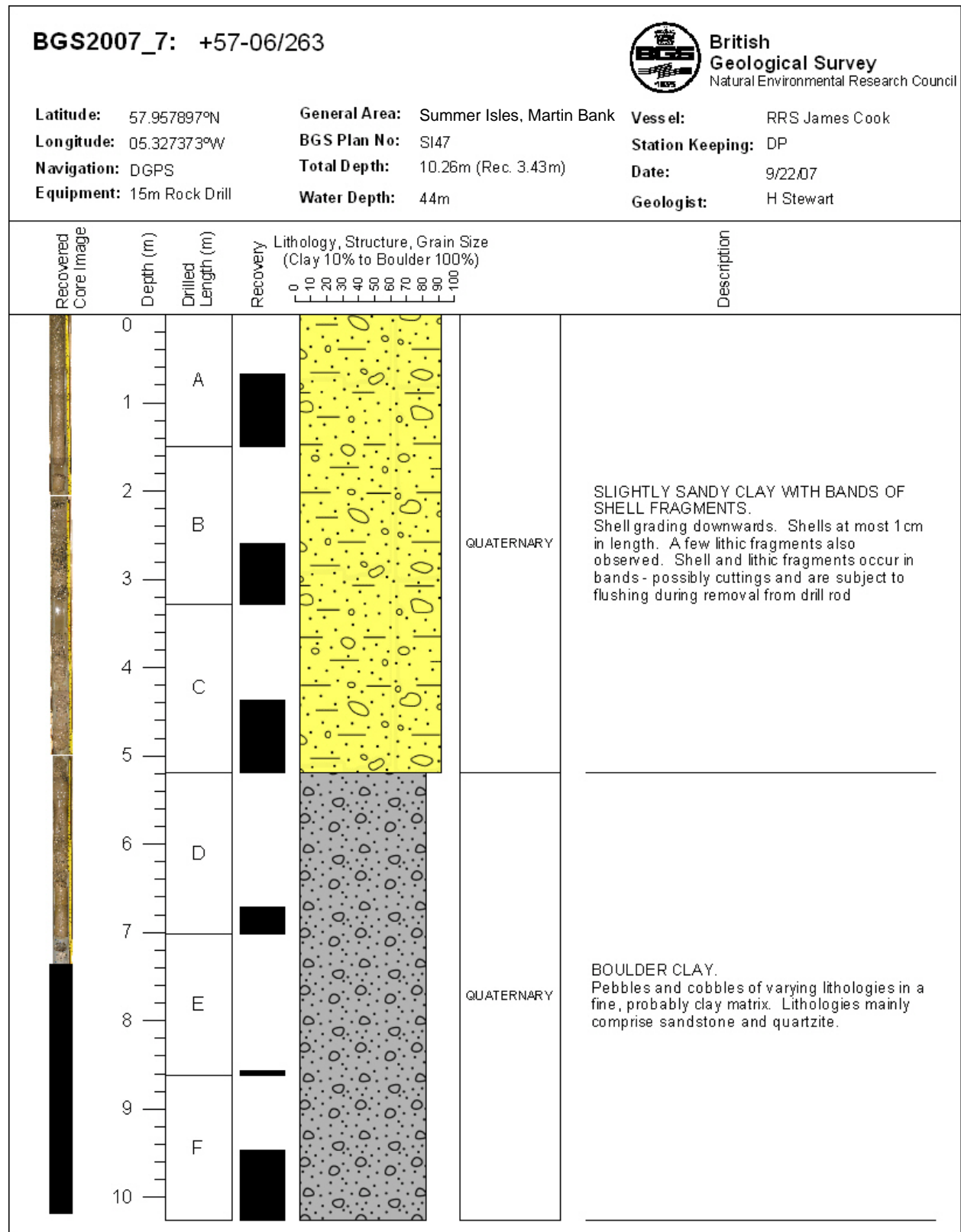
Location Summer Isles, Martin Bank



Sample +57-06/263

Original Site Number: SI47

Location Summer Isles, Martin Bank



Sample +57-06/263

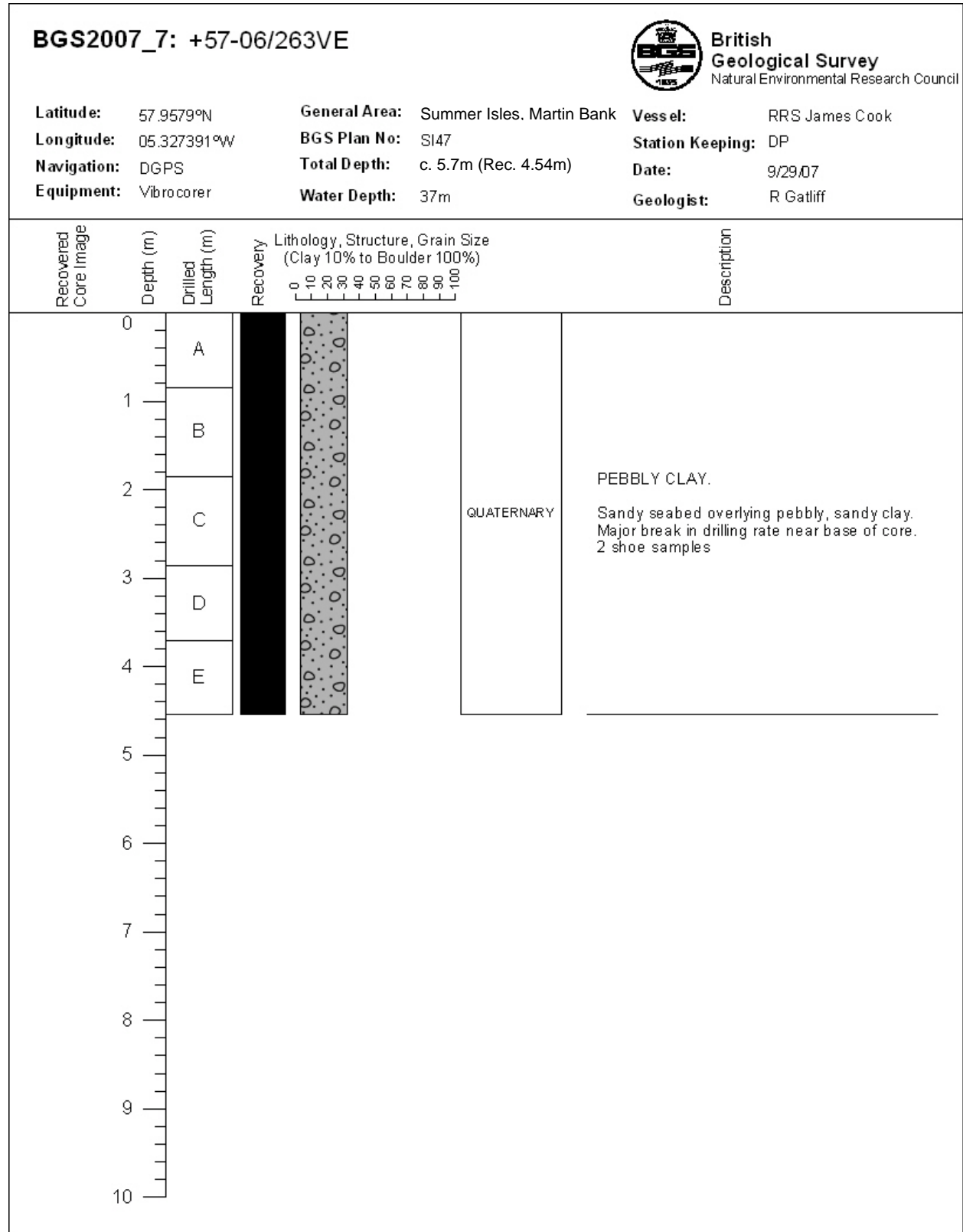
Core photograph



Sample +57-06/263VE

Original Site Number: SI47

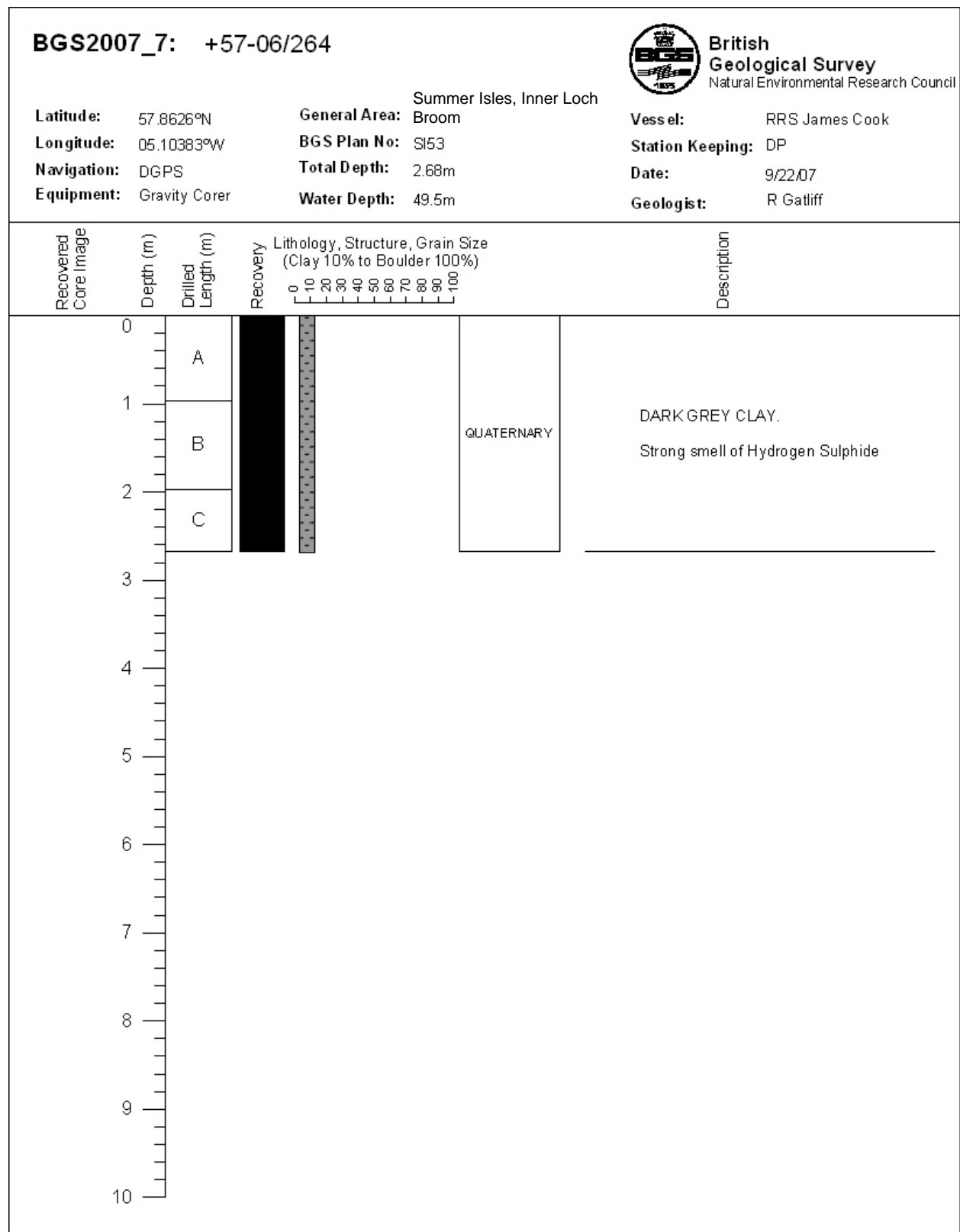
Location Summer Isles, Martin Bank



Sample +57-06/264CS

Original Site Number: SI53

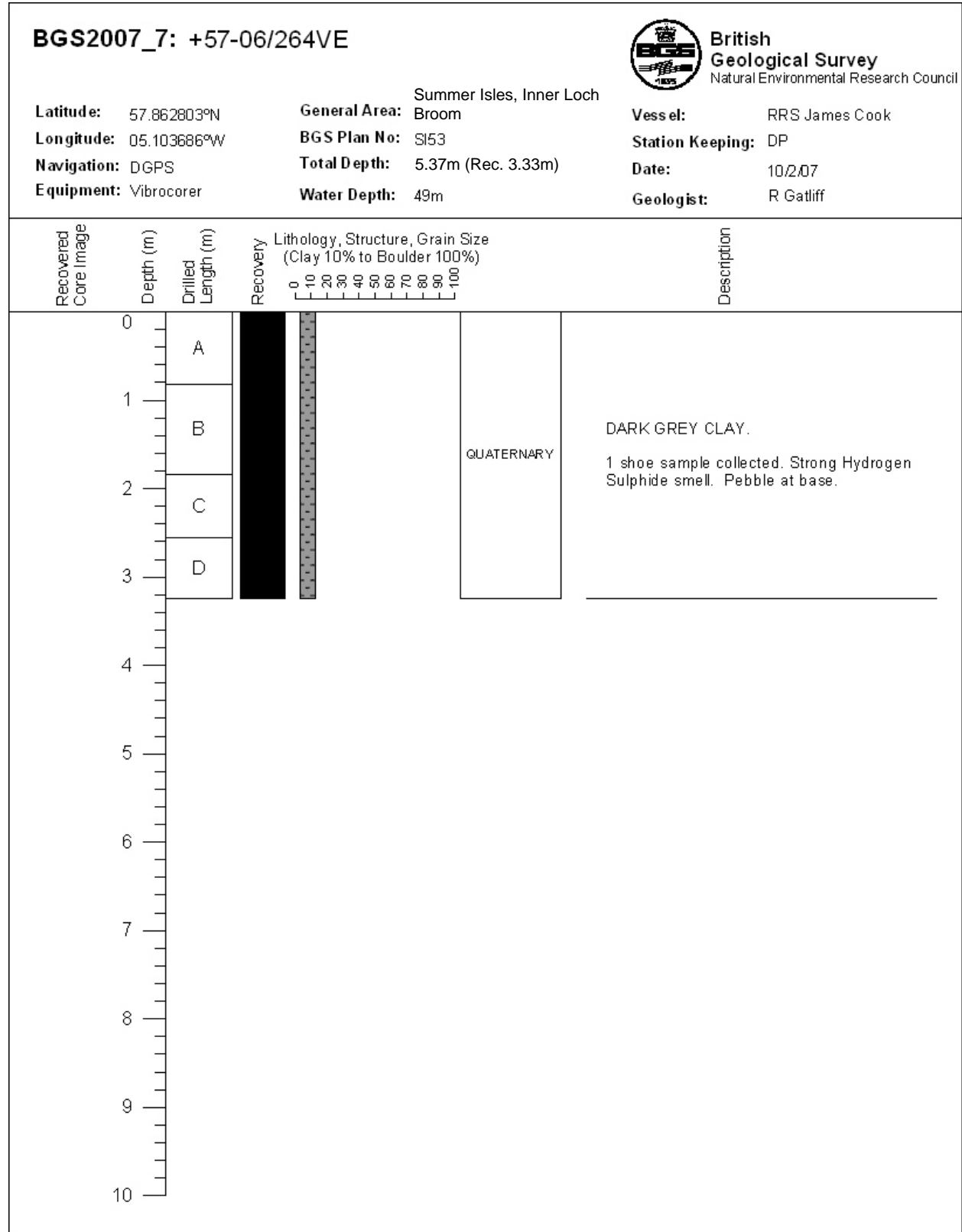
Location Summer Isles, Inner Loch Broom



Sample +57-06/264VE

Original Site Number: SI53

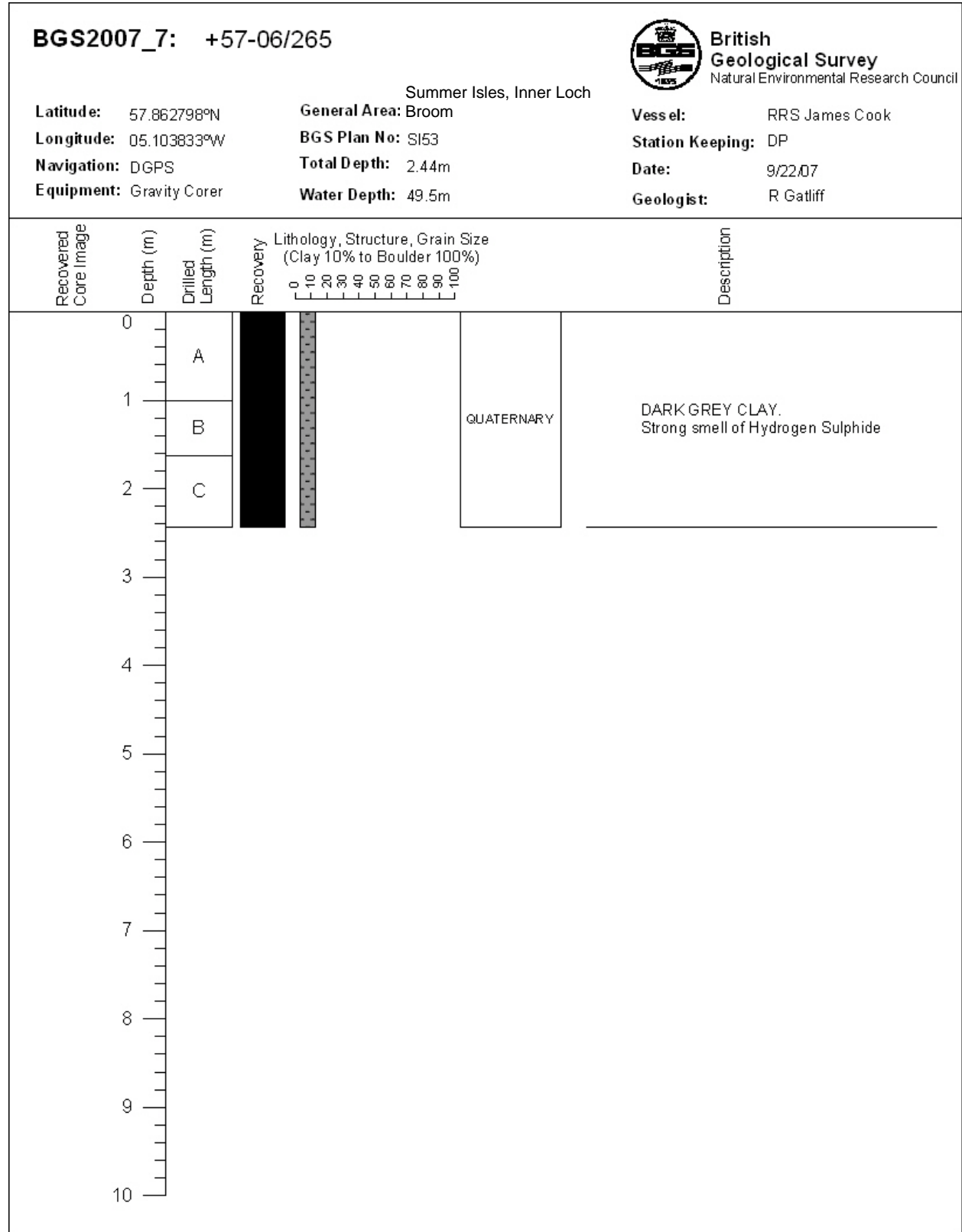
Location Summer Isles, Inner Loch Broom



Sample +57-06/265CS

Original Site Number: SI53

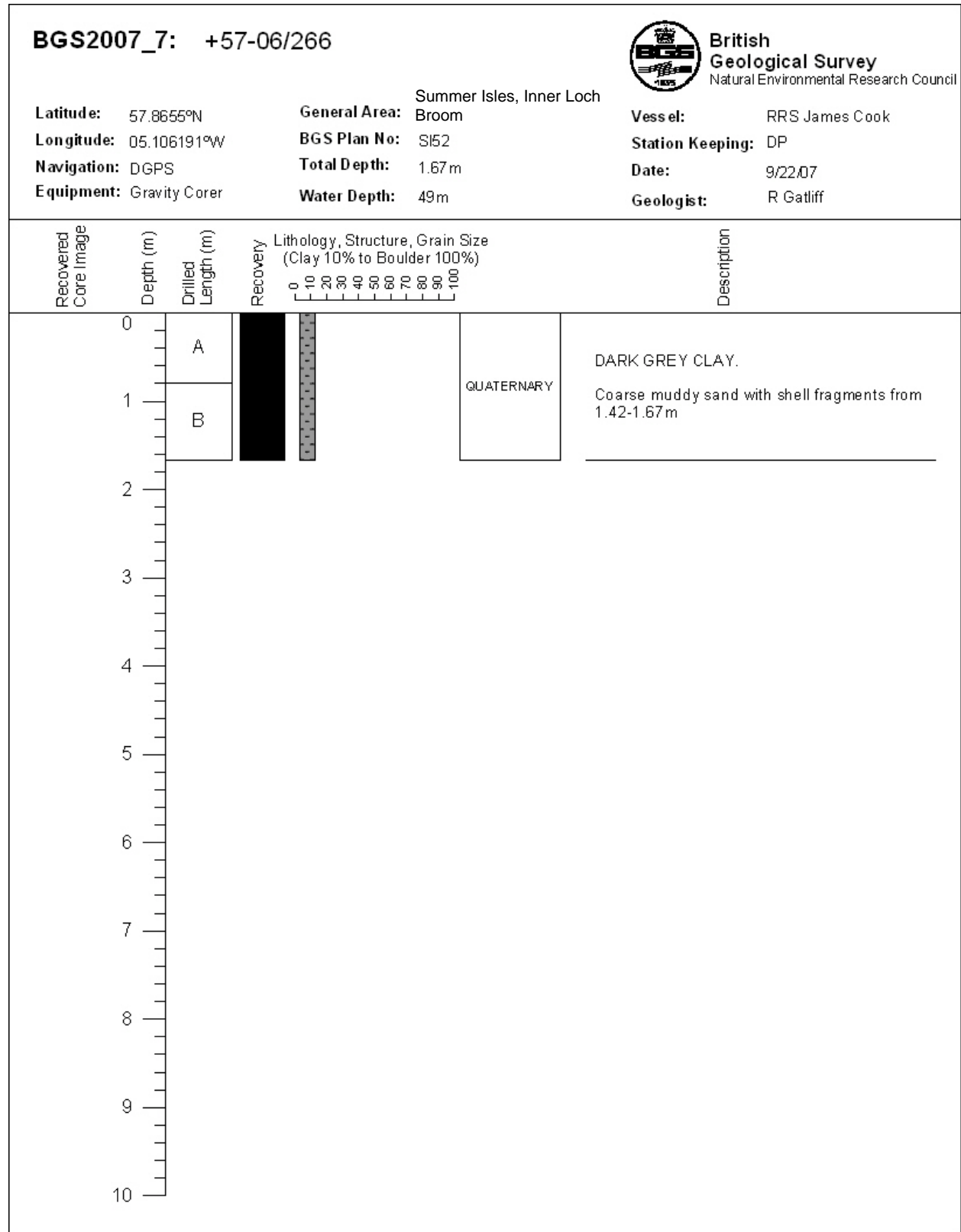
Location Summer Isles, Inner Loch Broom



Sample +57-06/266CS

Original Site Number: SI52

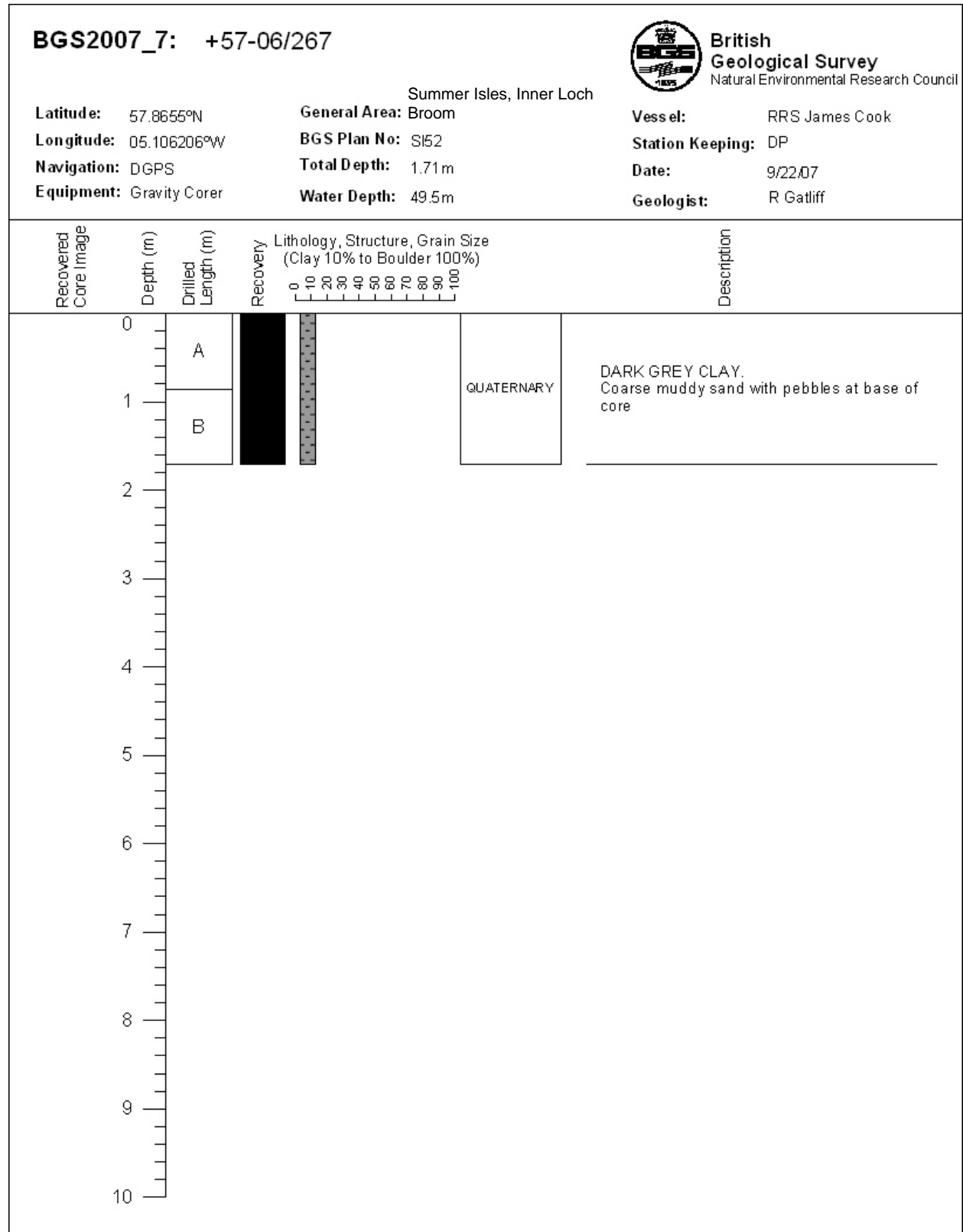
Location Summer Isles, Inner Loch Broom



Sample +57-06/267CS

Original Site Number: SI52

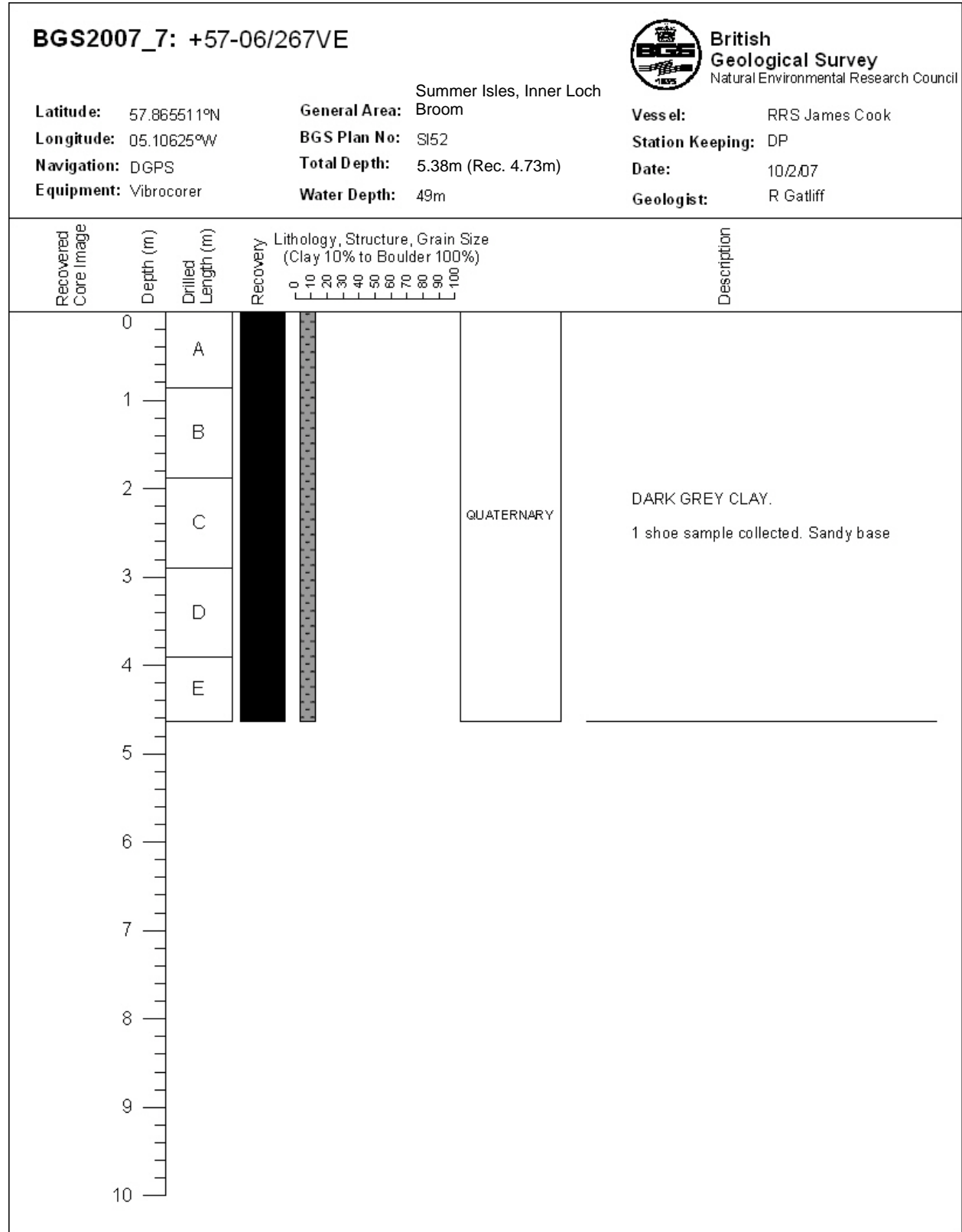
Location Summer Isles, Inner Loch Broom



Sample +57-06/267VE

Original Site Number: SI52

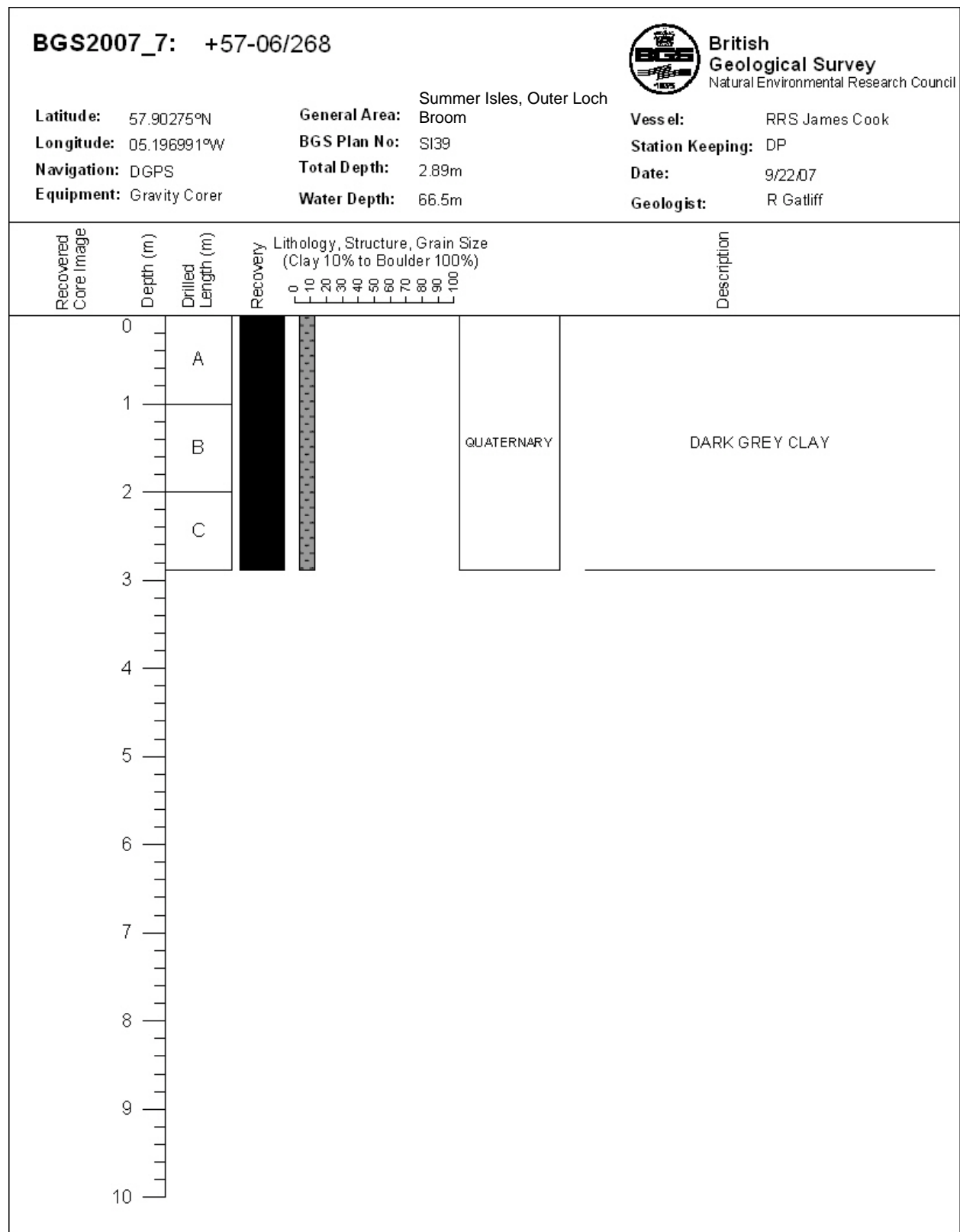
Location Summer Isles, Inner Loch Broom



Sample +57-06/268CS

Original Site Number: SI39

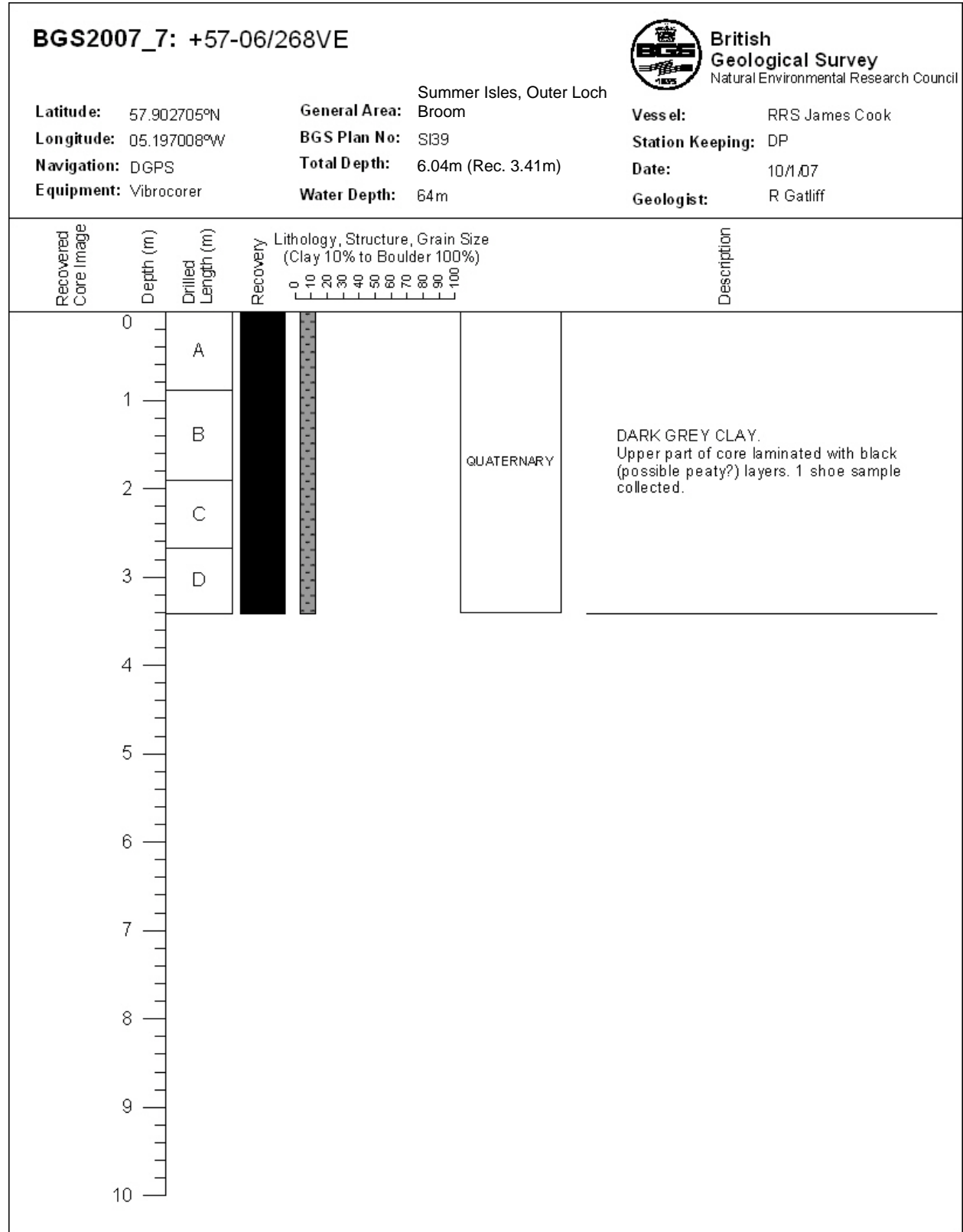
Location Summer Isles, Outer Loch Broom



Sample +57-06/268VE

Original Site Number: SI39

Location Summer Isles, Outer Loch Broom



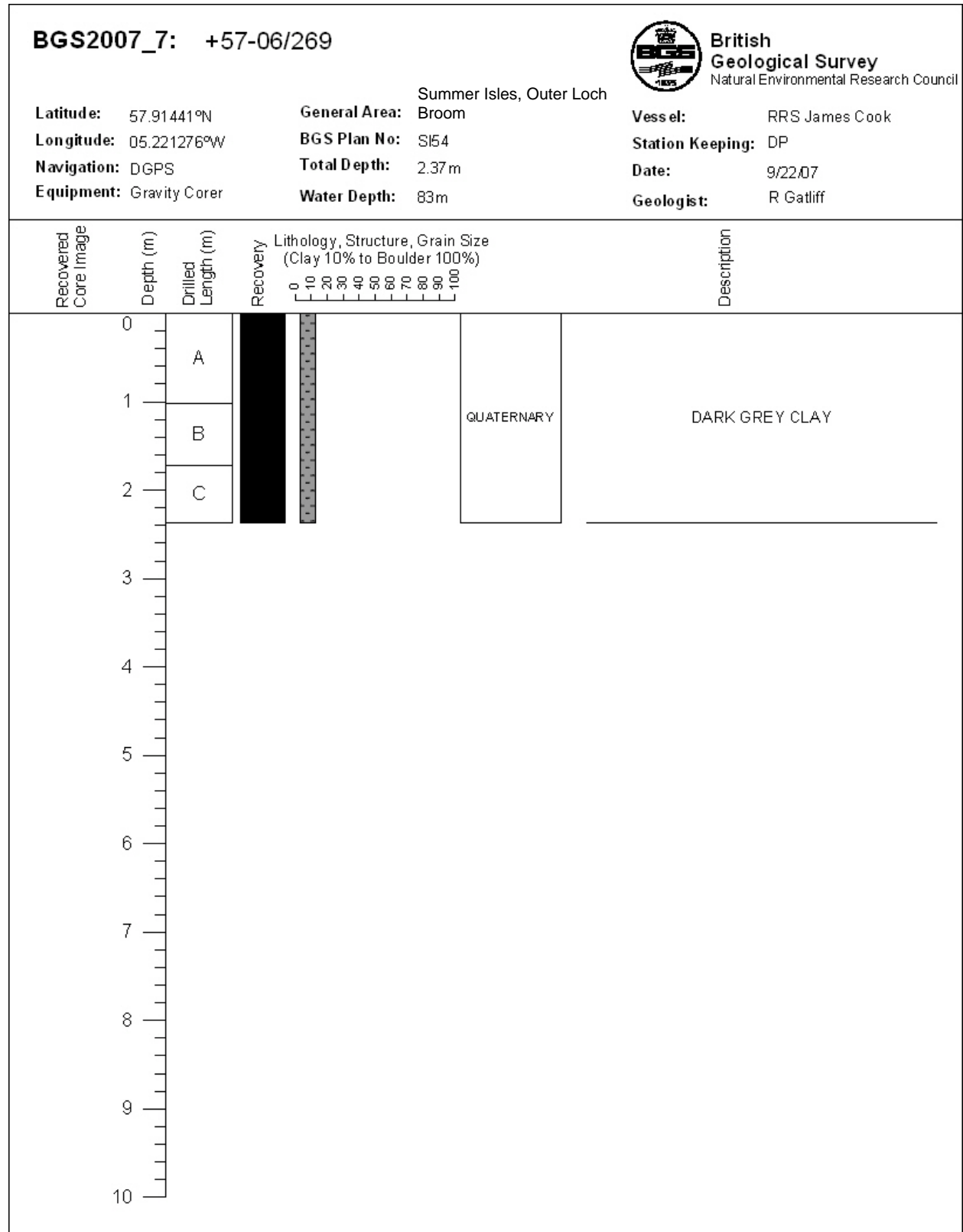
QUATERNARY

DARK GREY CLAY.
 Upper part of core laminated with black (possible peaty?) layers. 1 shoe sample collected.

Sample +57-06/269CS

Original Site Number: SI54

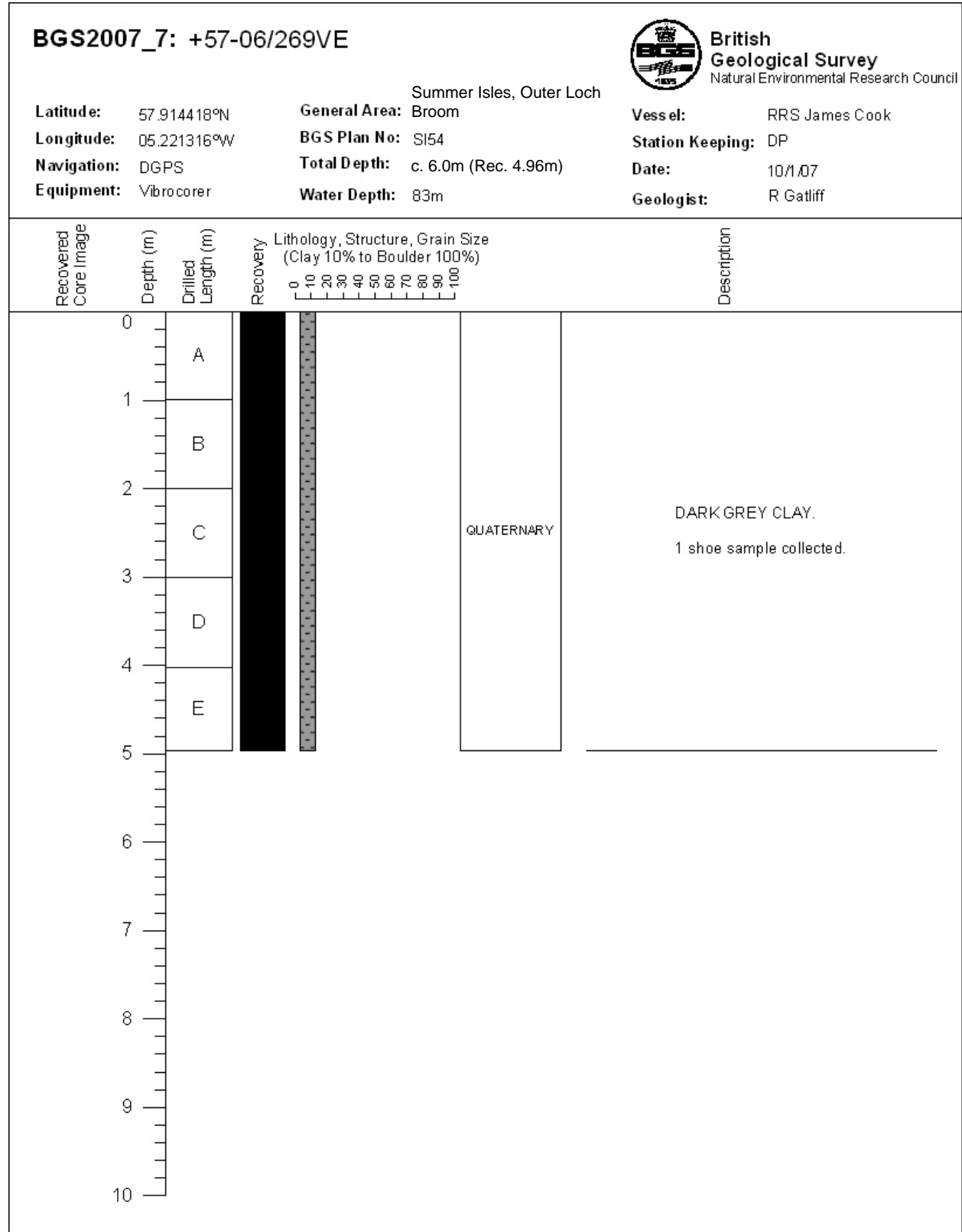
Location Summer Isles, Outer Loch Broom



Sample +57-06/269VE

Original Site Number: SI54

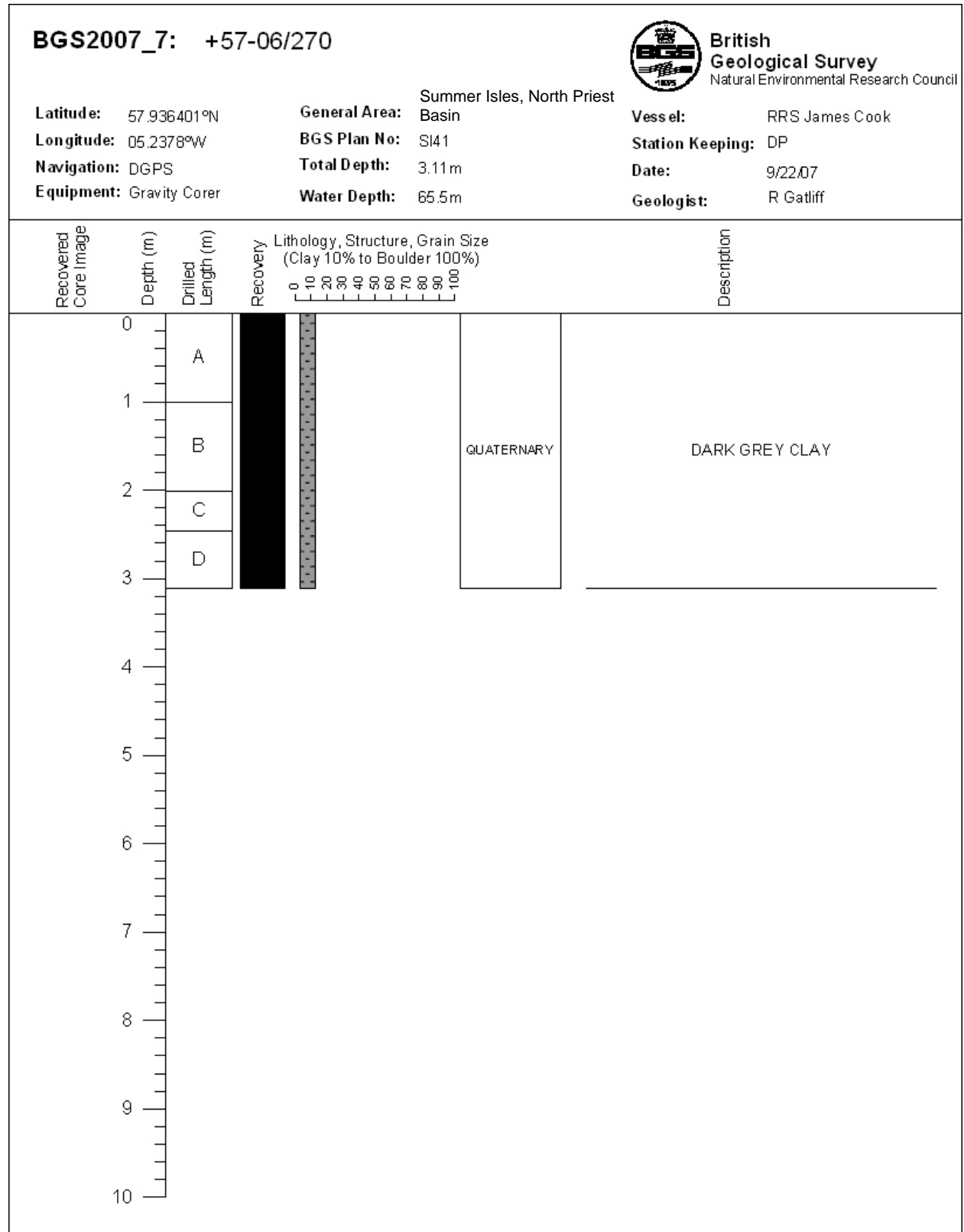
Location Summer Isles, Outer Loch Broom



Sample +57-06/270CS

Original Site Number: SI41

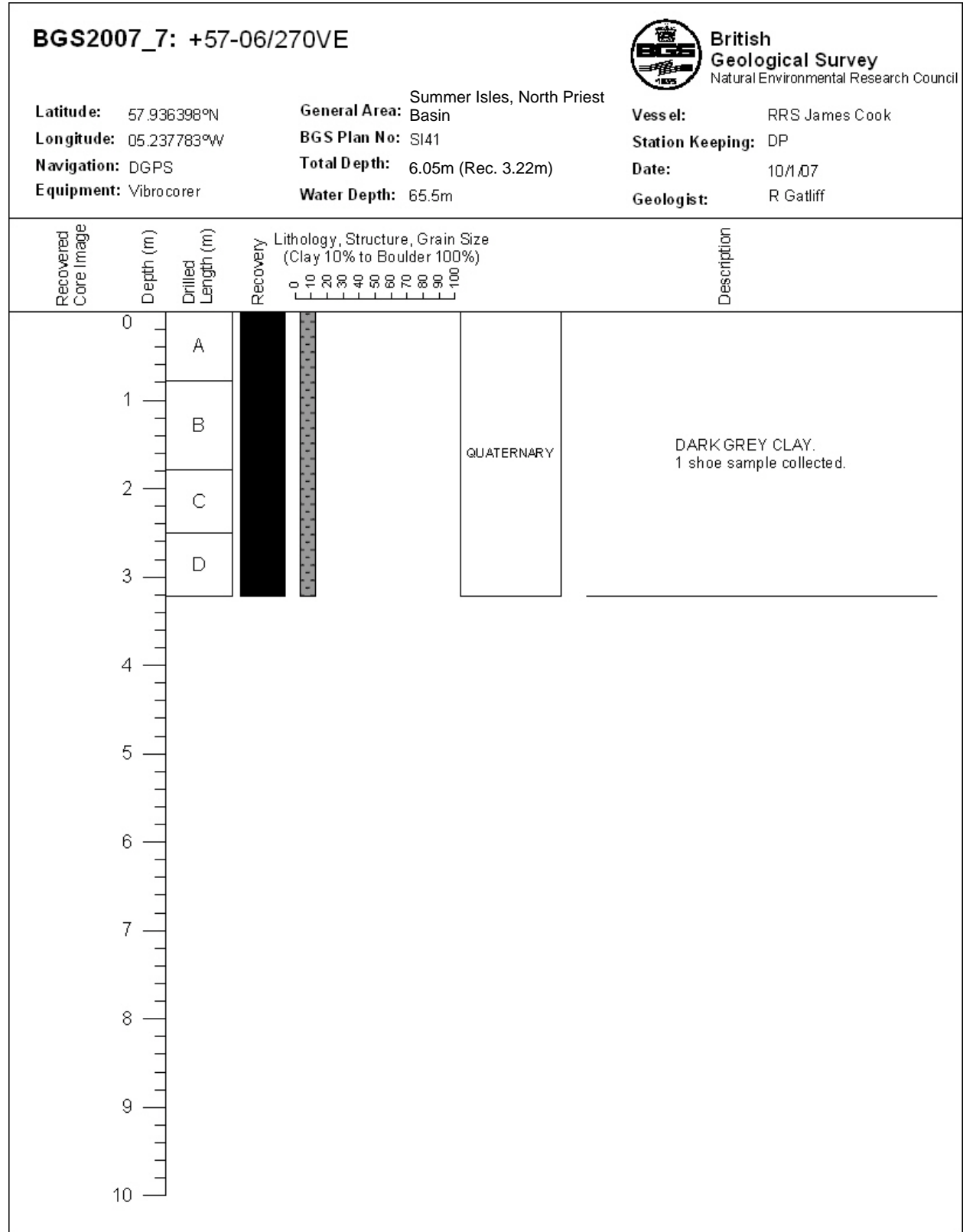
Location Summer Isles, North Priest Basin



Sample +57-06/270VE

Original Site Number: SI41

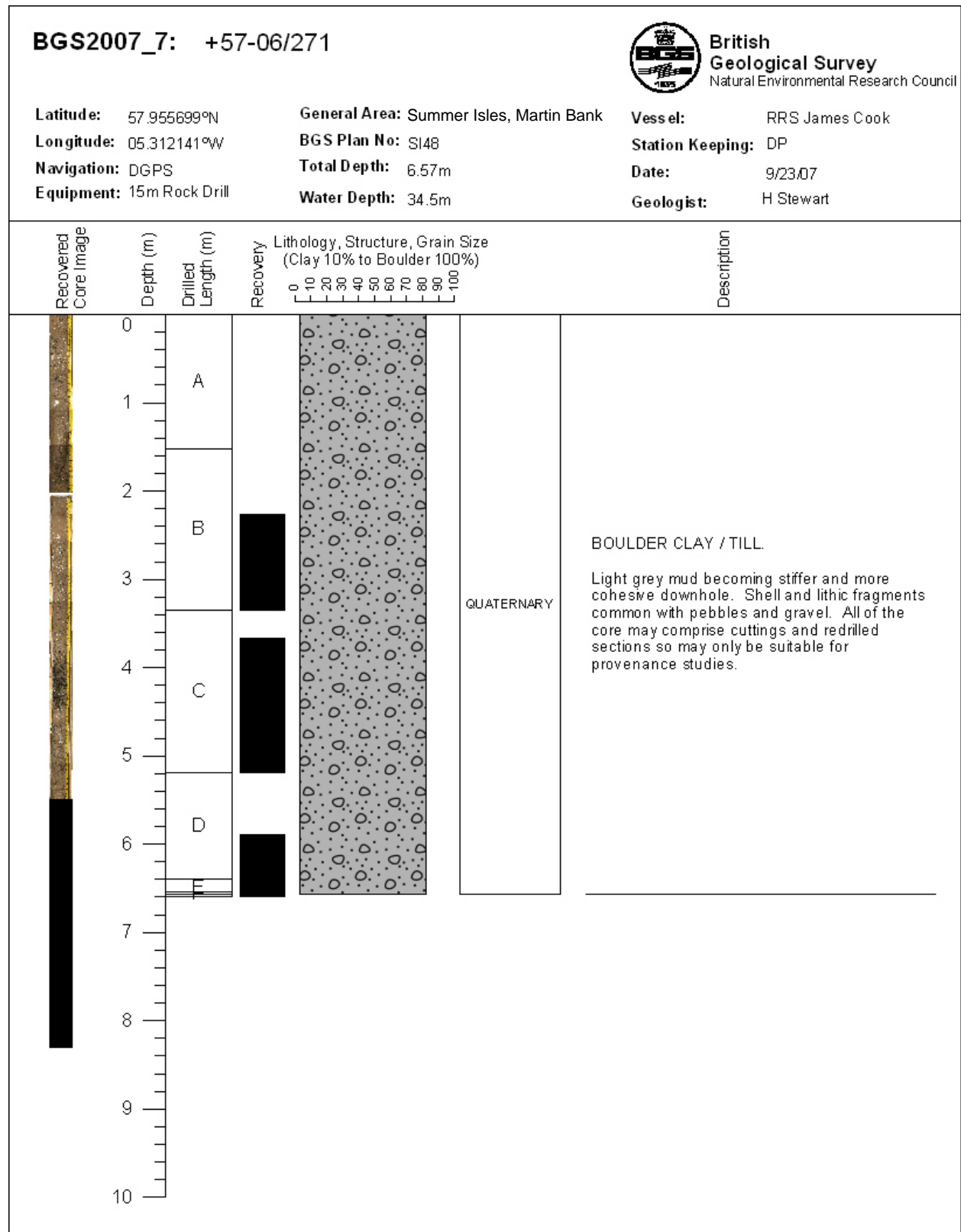
Location Summer Isles, North Priest Basin



Sample +57-06/271

Original Site Number: SI48

Location Summer Isles, Martin Bank



Sample +57-06/271

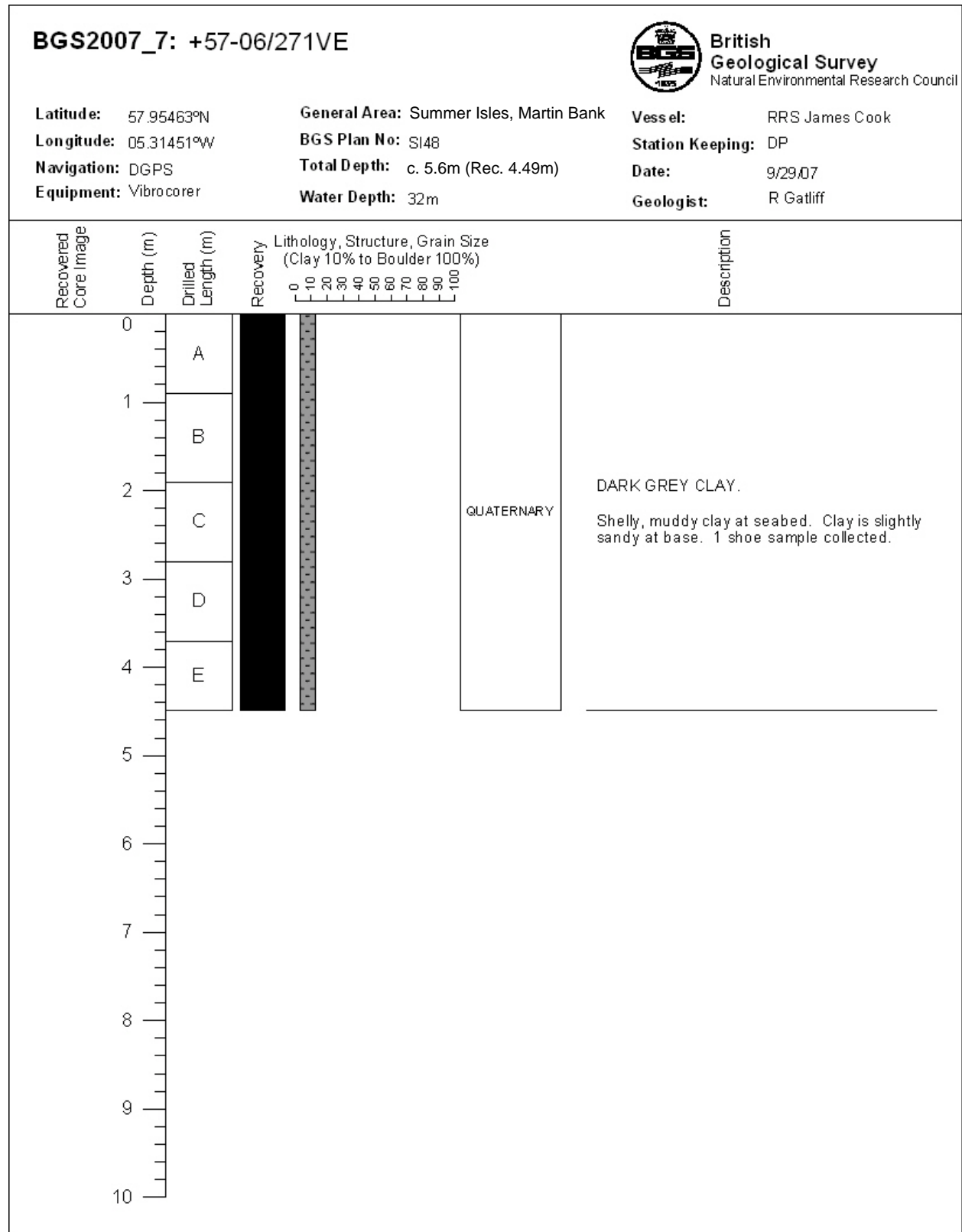
Core photograph



Sample +57-06/271VE

Original Site Number: SI48

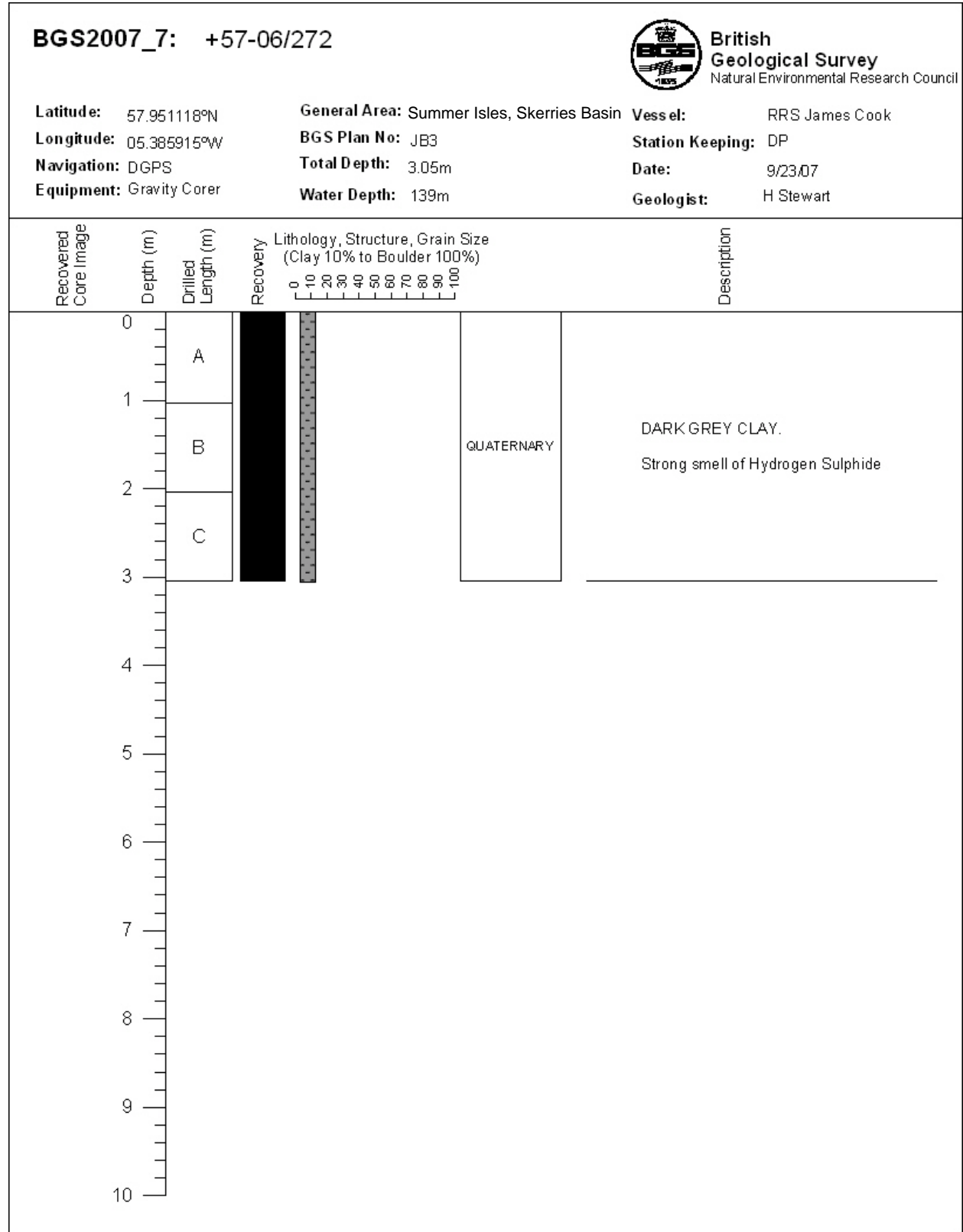
Location Summer Isles, Martin Bank



Sample +57-06/272CS

Original Site Number: JB3

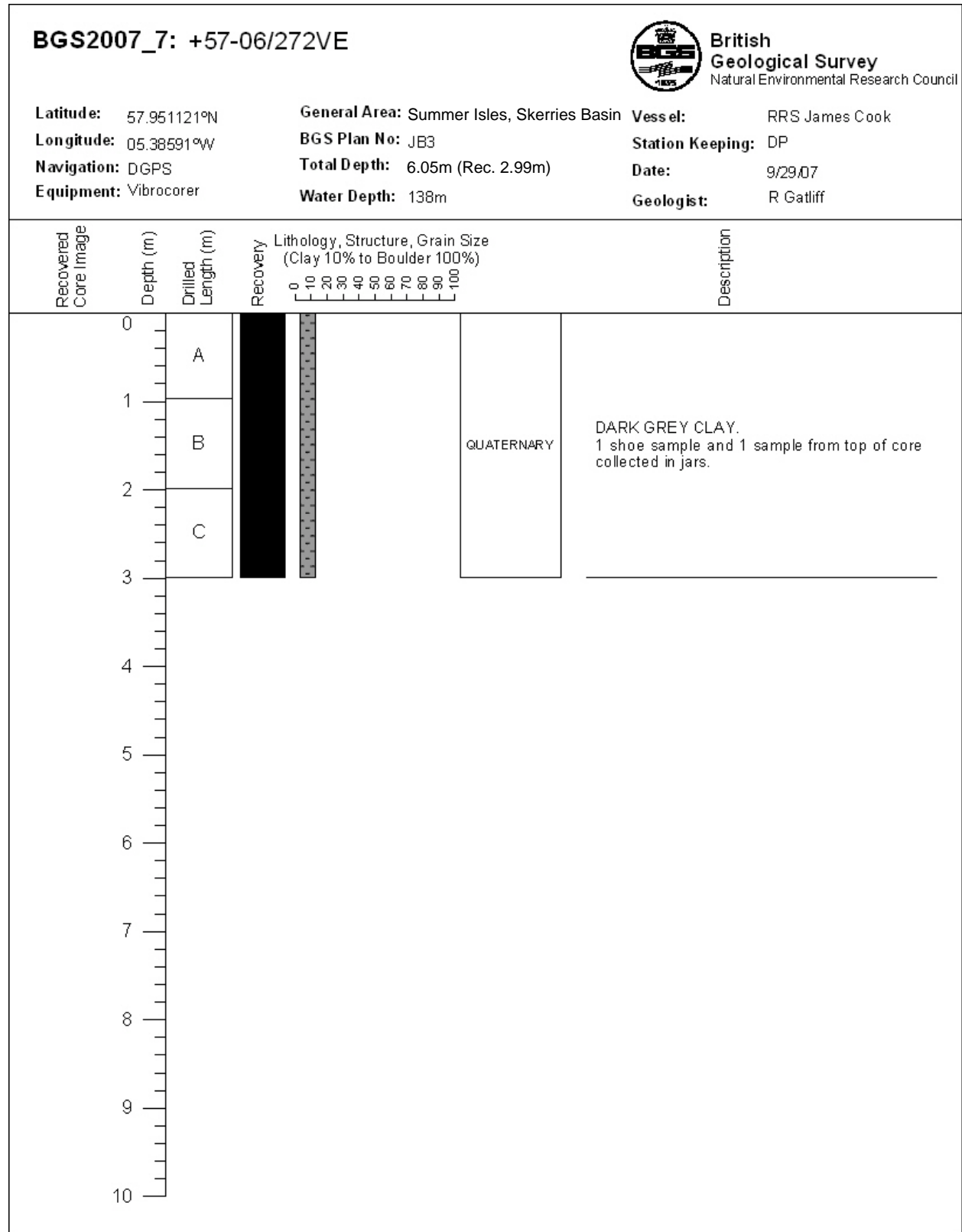
Location Summer Isles, Skerries Basin



Sample +57-06/272VE

Original Site Number: JB3

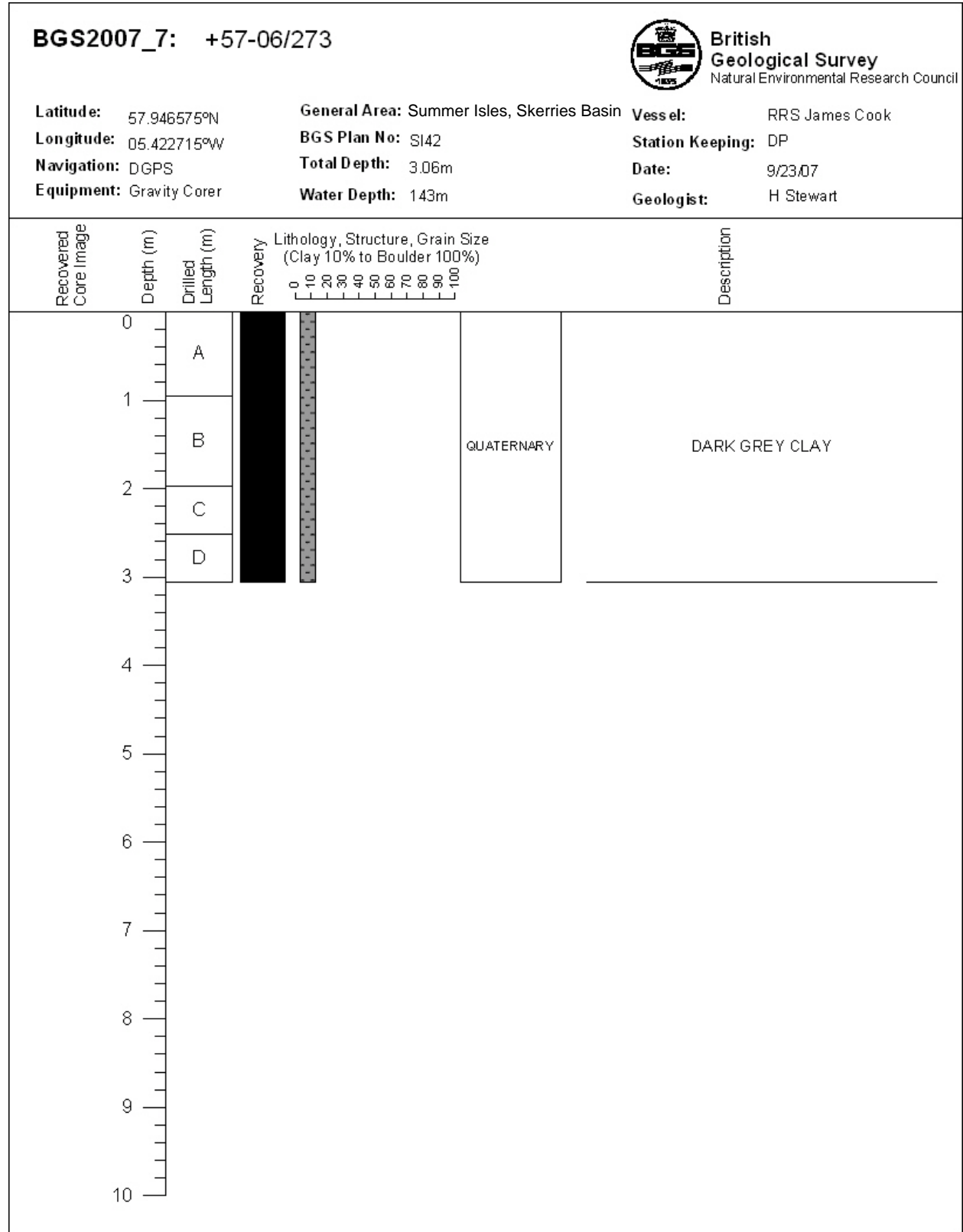
Location Summer Isles, Skerries Basin



Sample +57-06/273CS

Original Site Number: SI42

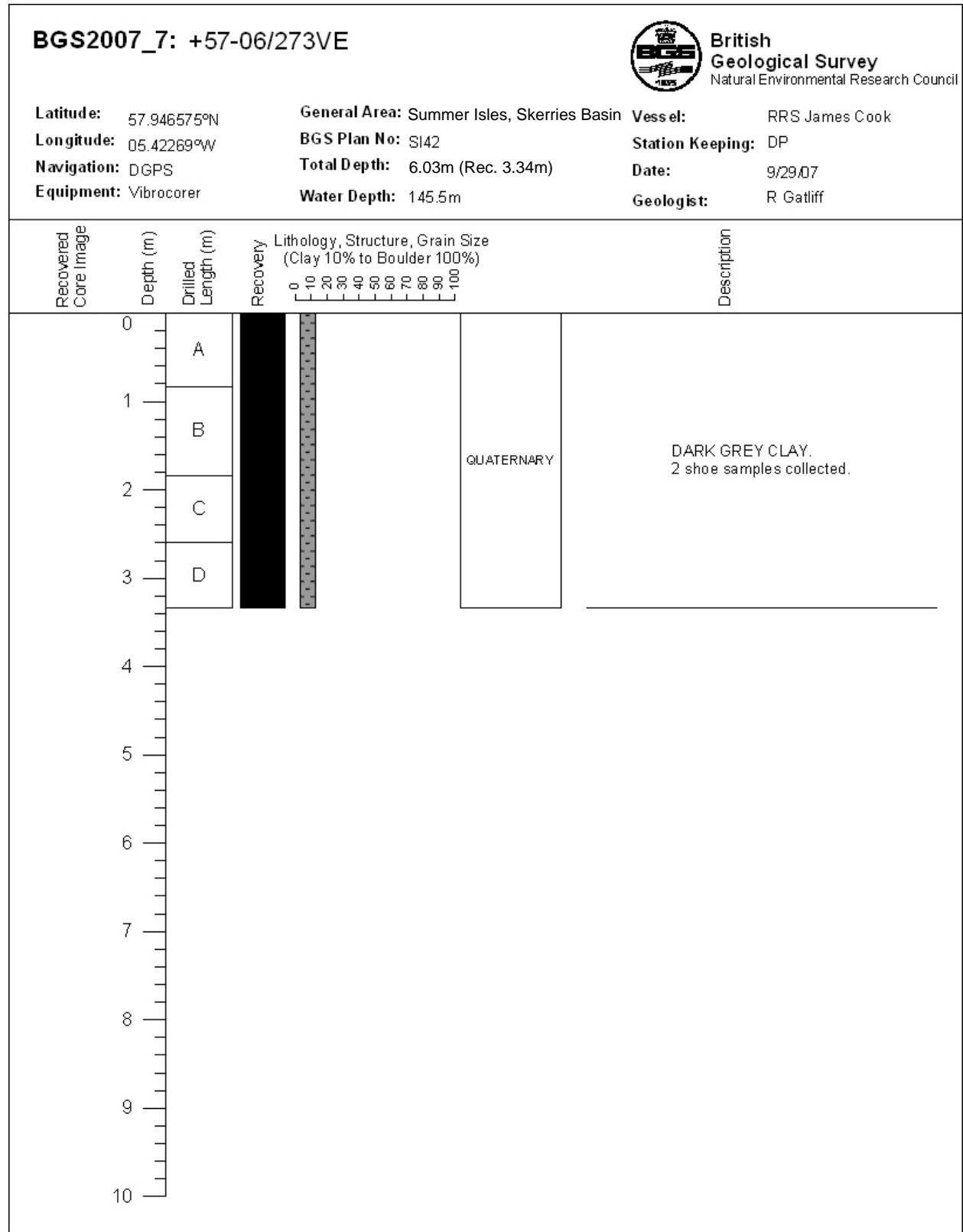
Location Summer Isles, Skerries Basin



Sample +57-06/273VE

Original Site Number: SI42

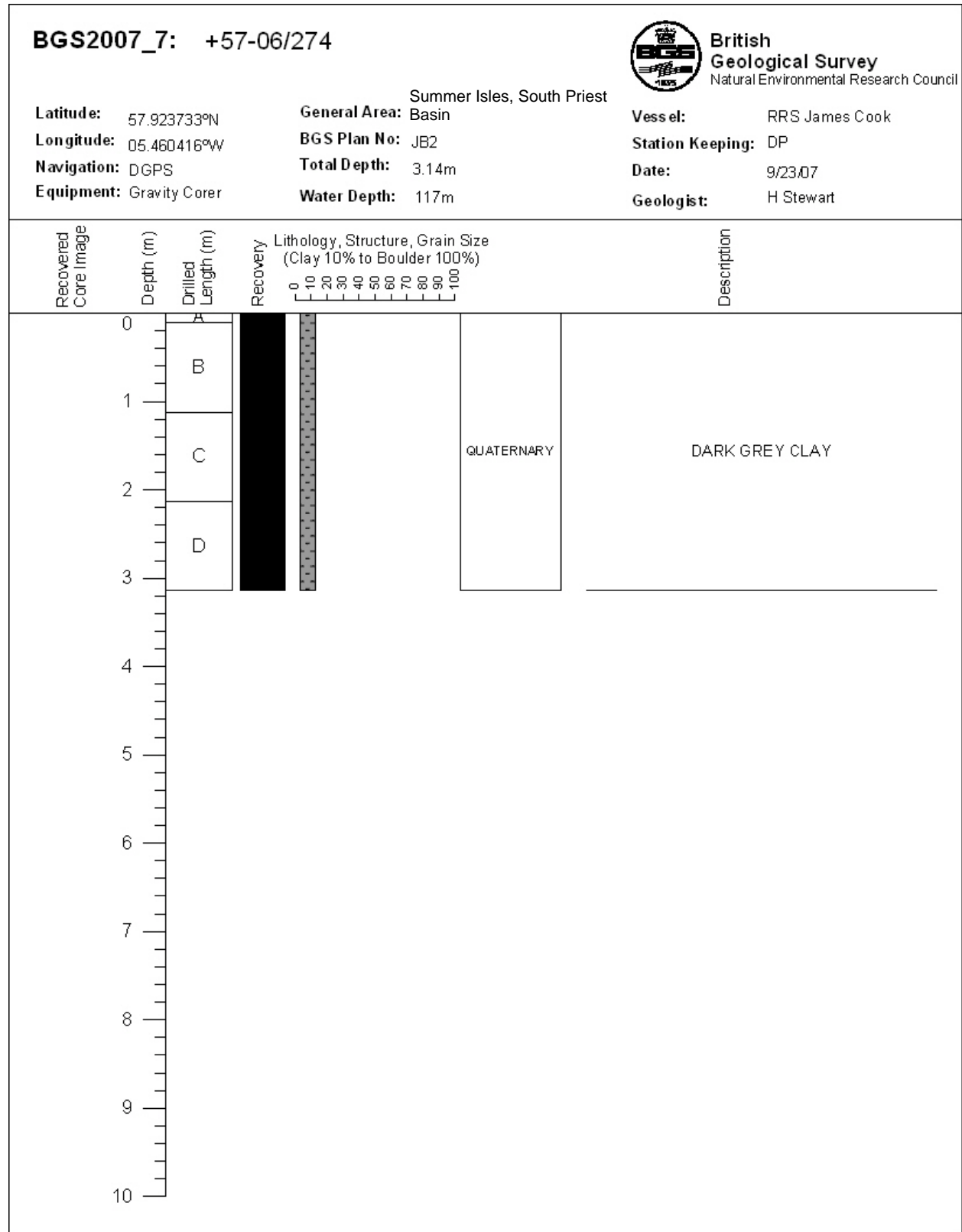
Location Summer Isles, Skerries Basin



Sample +57-06/274CS

Original Site Number: JB2

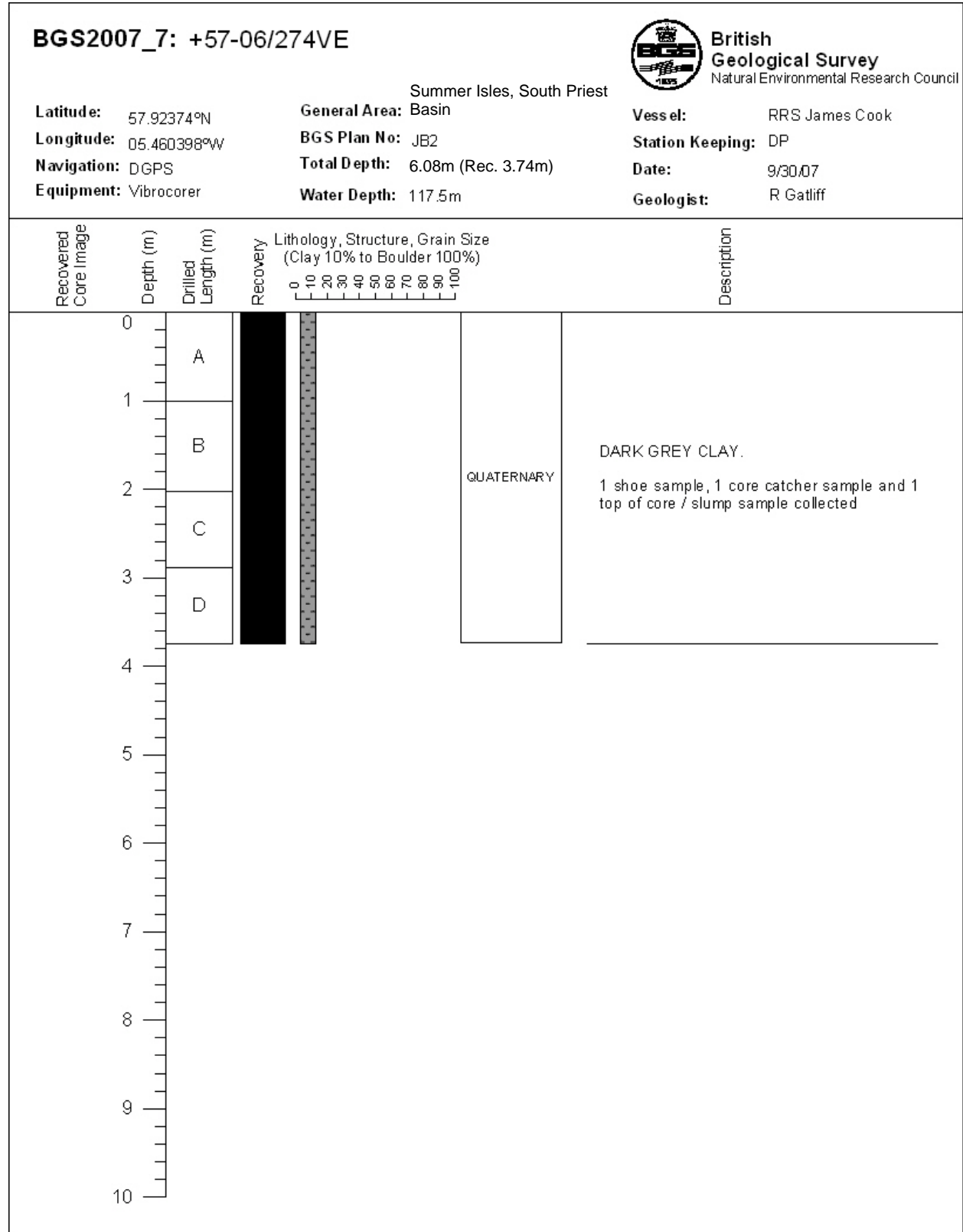
Location Summer Isles, South Priest Basin



Sample +57-06/274VE

Original Site Number: JB2

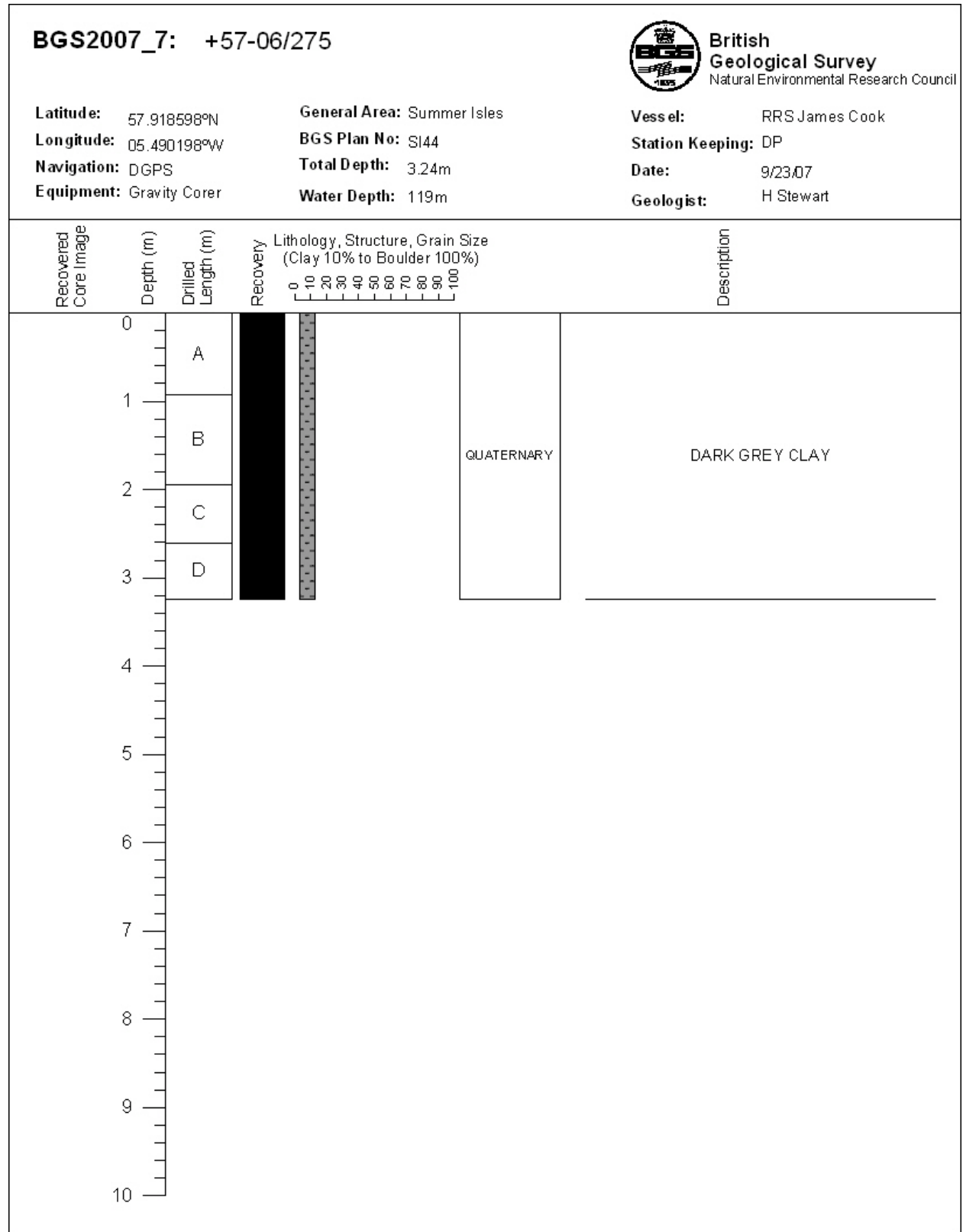
Location Summer Isles, South Priest Basin



Sample +57-06/275CS

Original Site Number: SI44

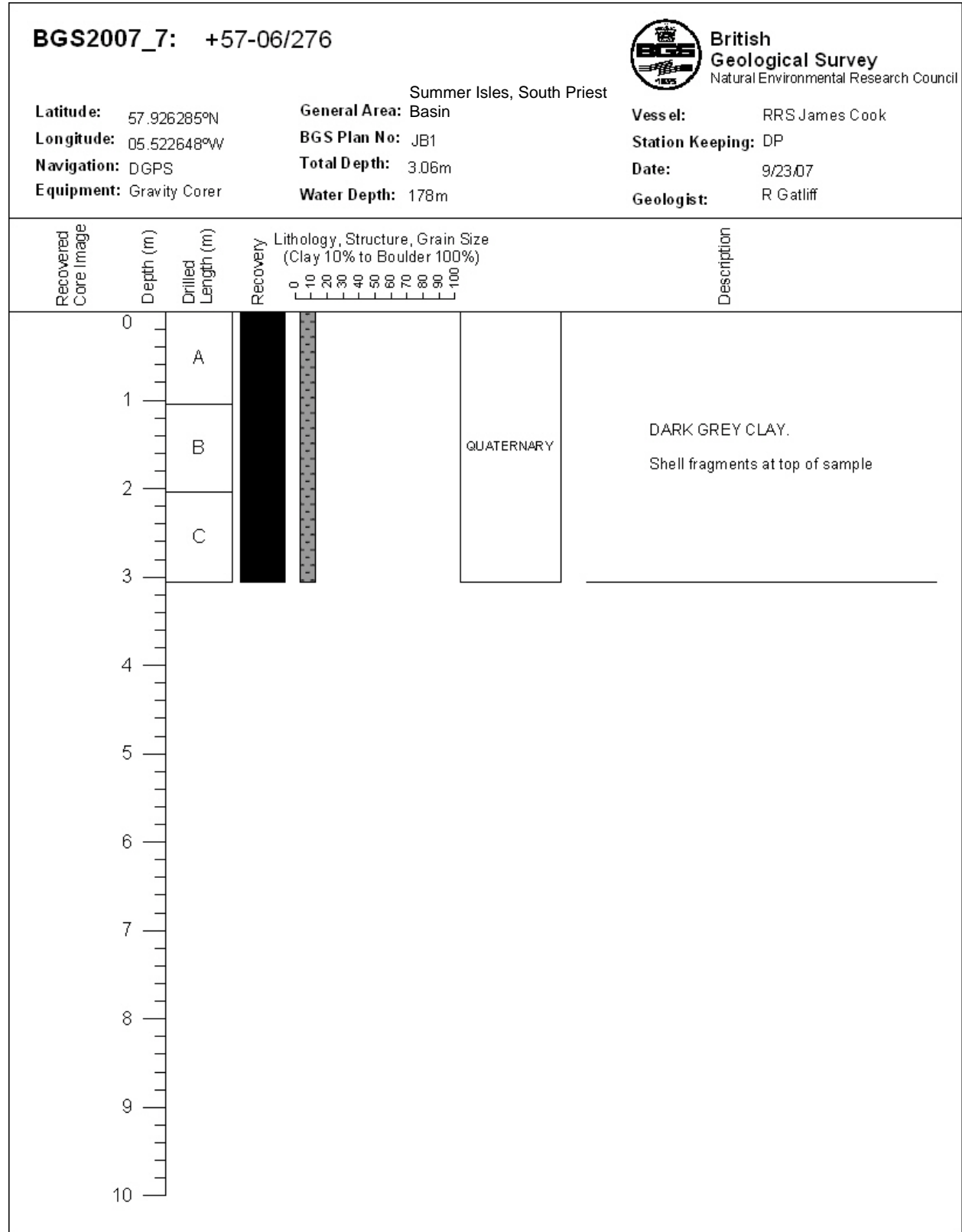
Location Summer Isles



Sample +57-06/276CS

Original Site Number: JB1

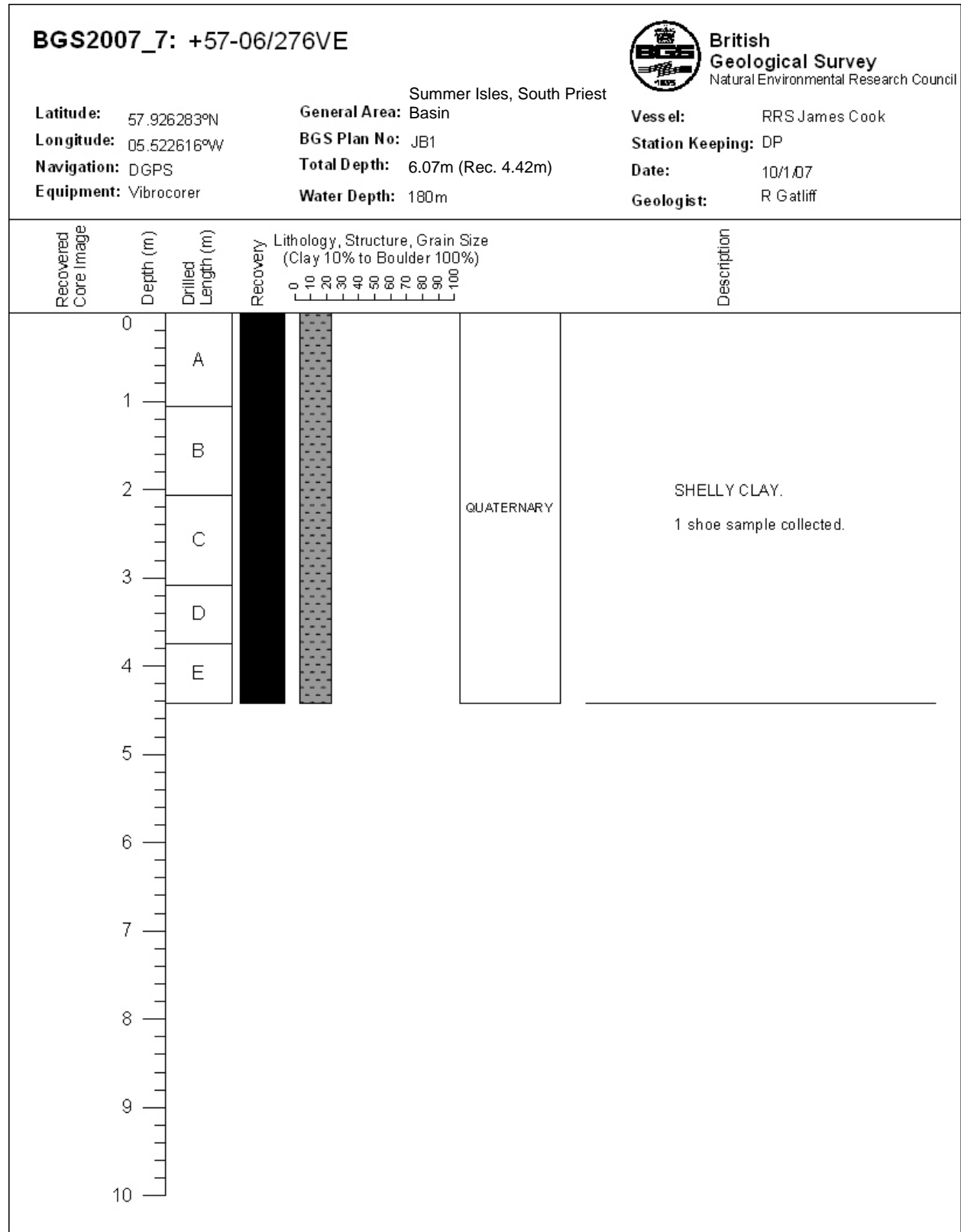
Location Summer Isles, South Priest Basin



Sample +57-06/276VE

Original Site Number: JB1

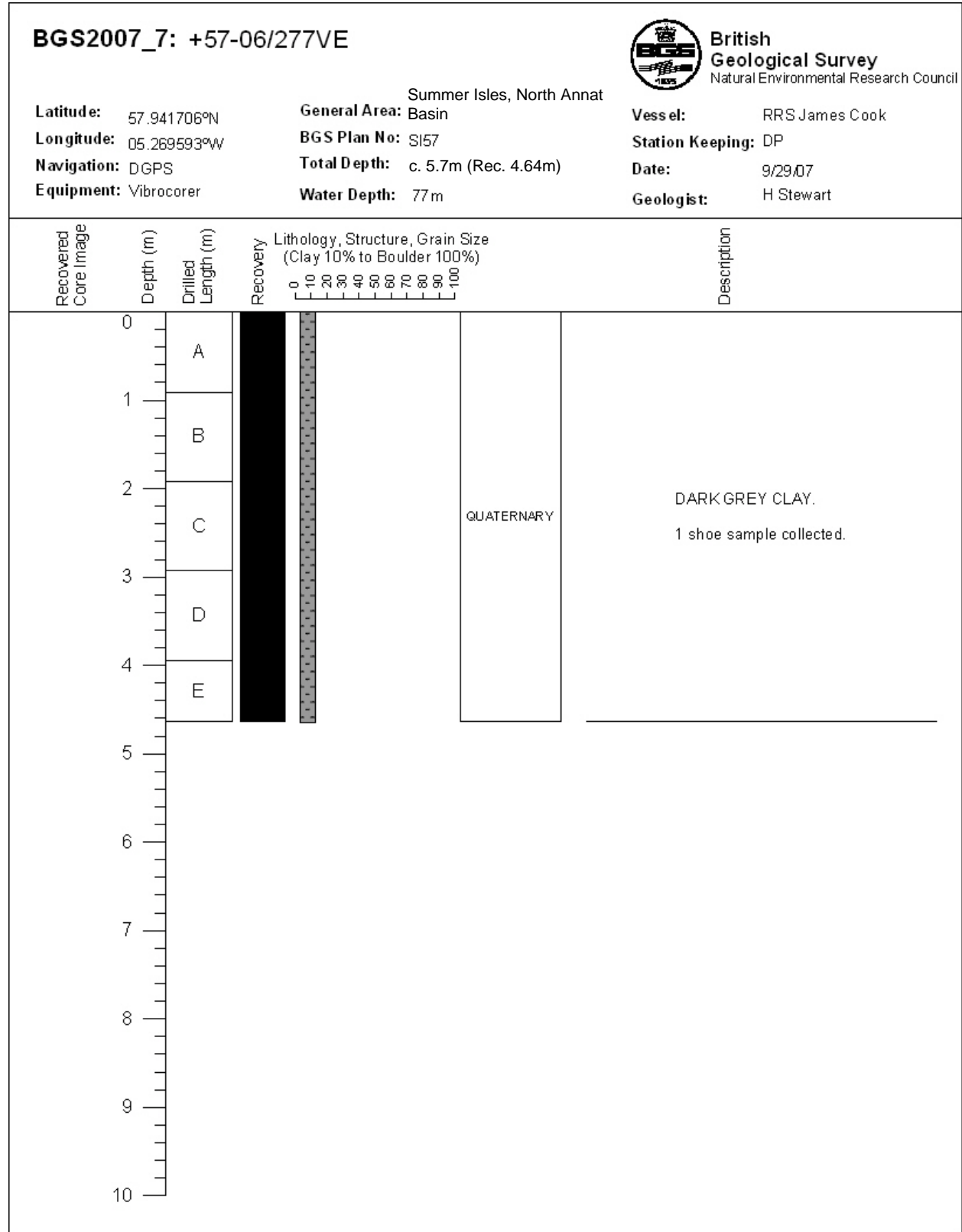
Location Summer Isles, South Priest Basin



Sample +57-06/277VE

Original Site Number: SI57

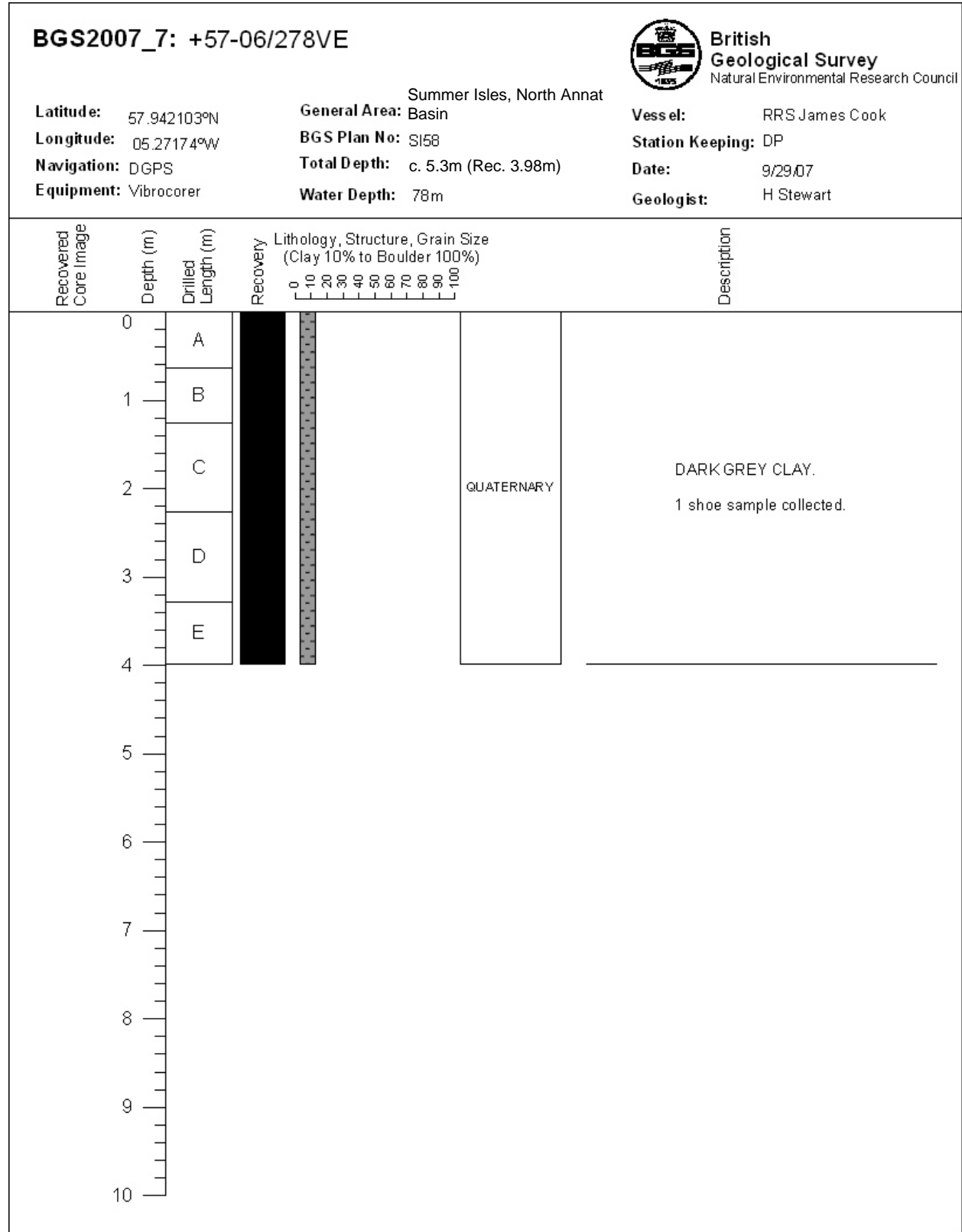
Location Summer Isles, North Annat Basin



Sample +57-06/278VE

Original Site Number: SI58

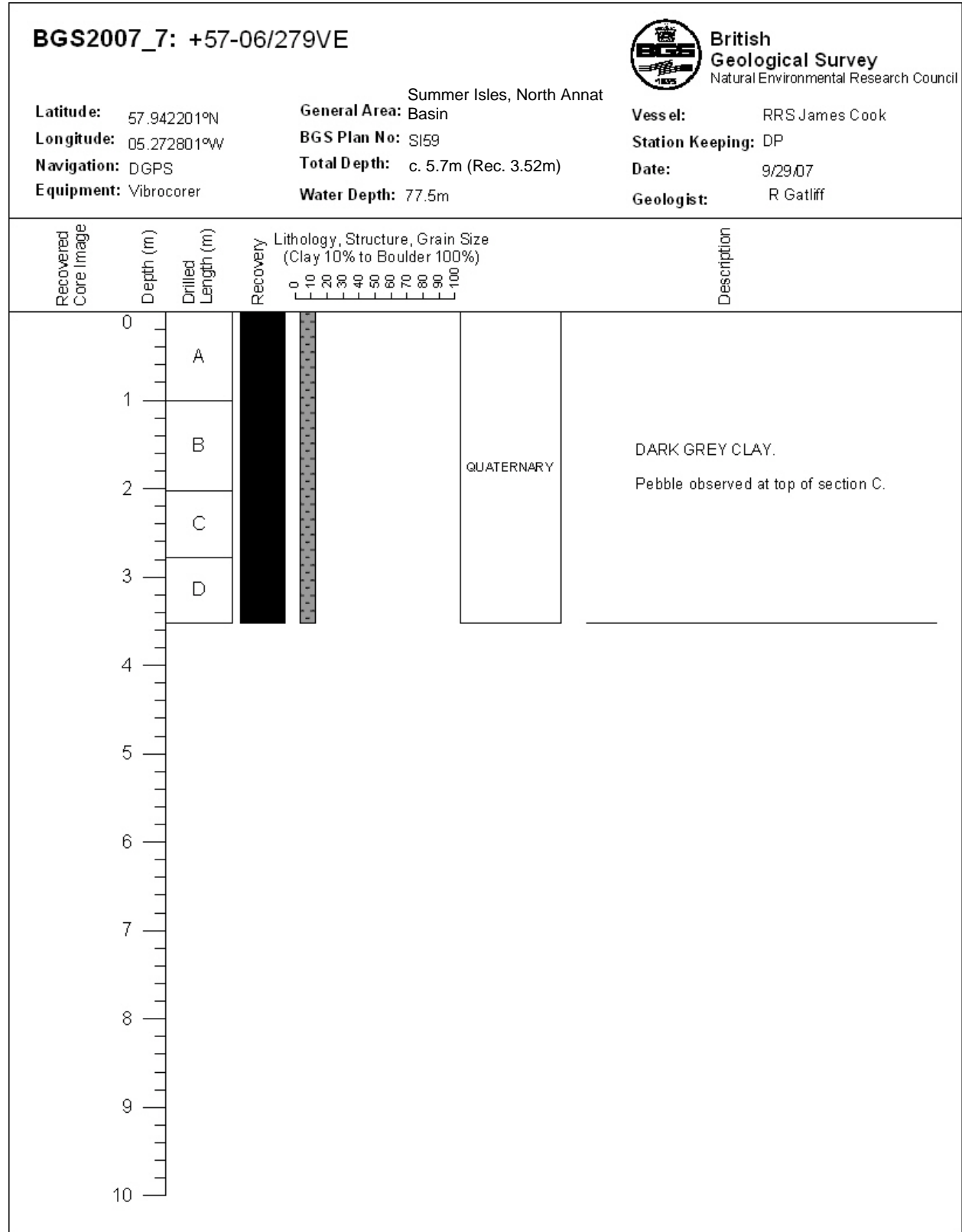
Location Summer Isles, North Annat Basin



Sample +57-06/279VE

Original Site Number: SI59

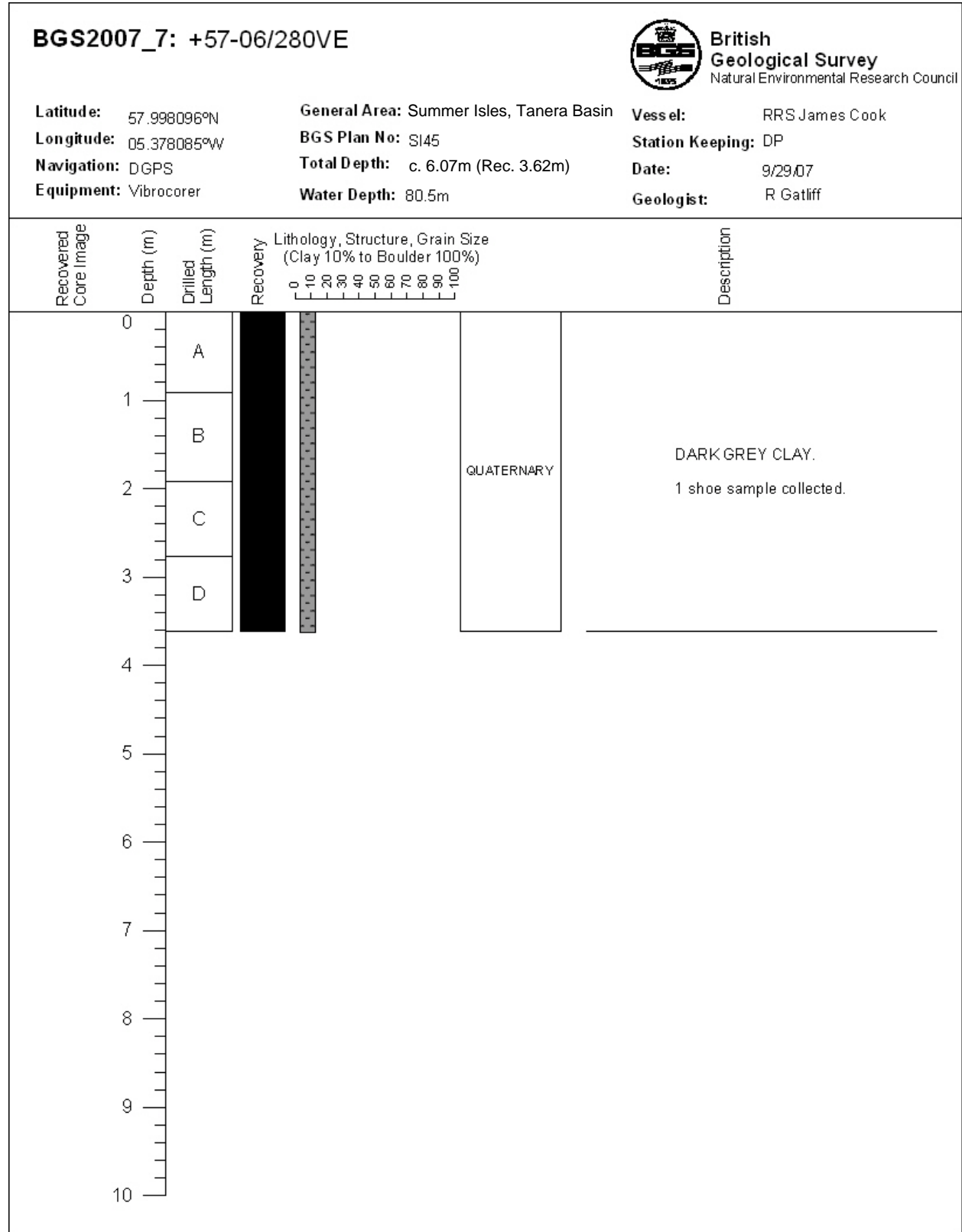
Location Summer Isles, North Annat Basin



Sample +57-06/280VE

Original Site Number: SI45

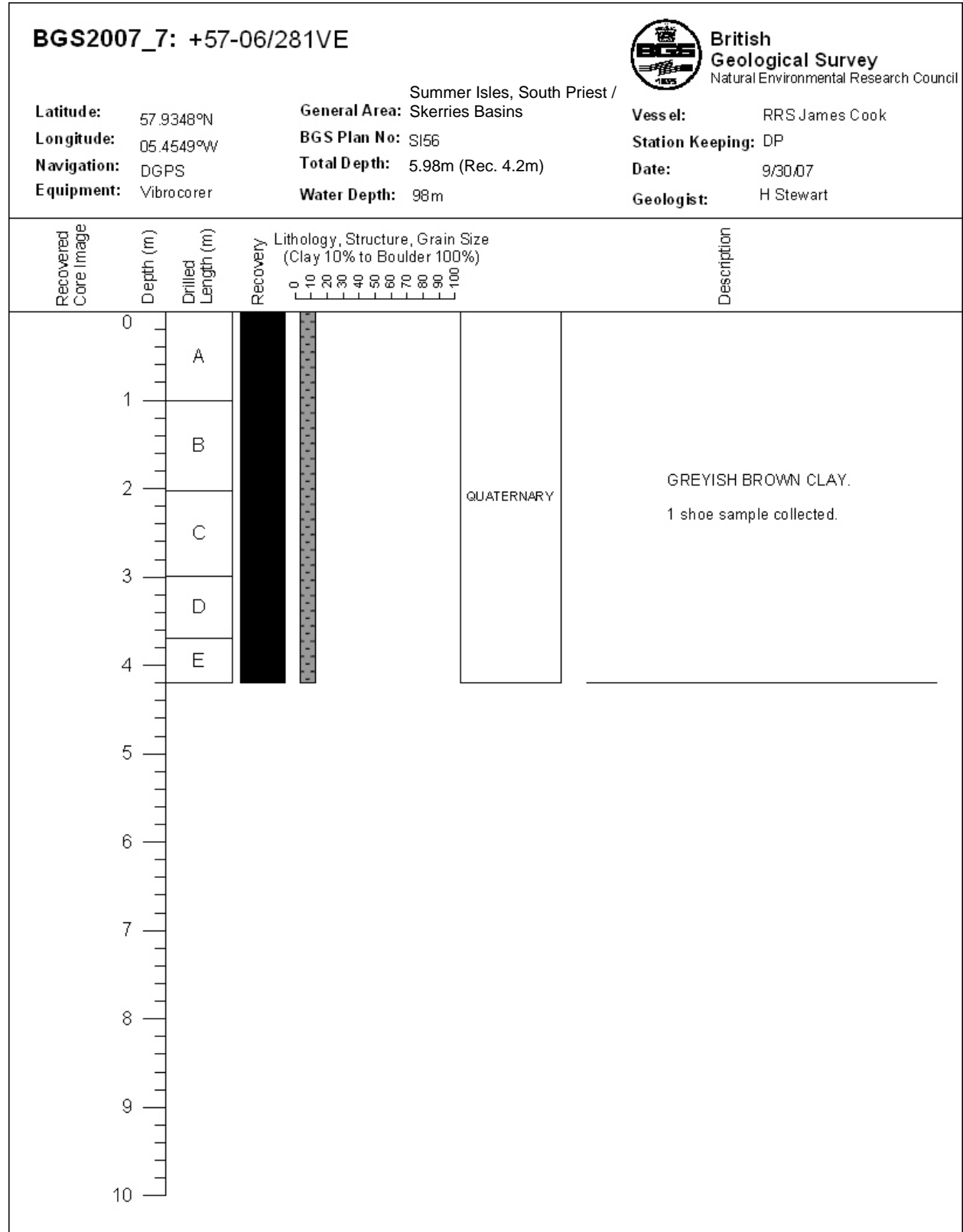
Location Summer Isles, Tanera Basin



Sample +57-06/281VE

Original Site Number: SI56

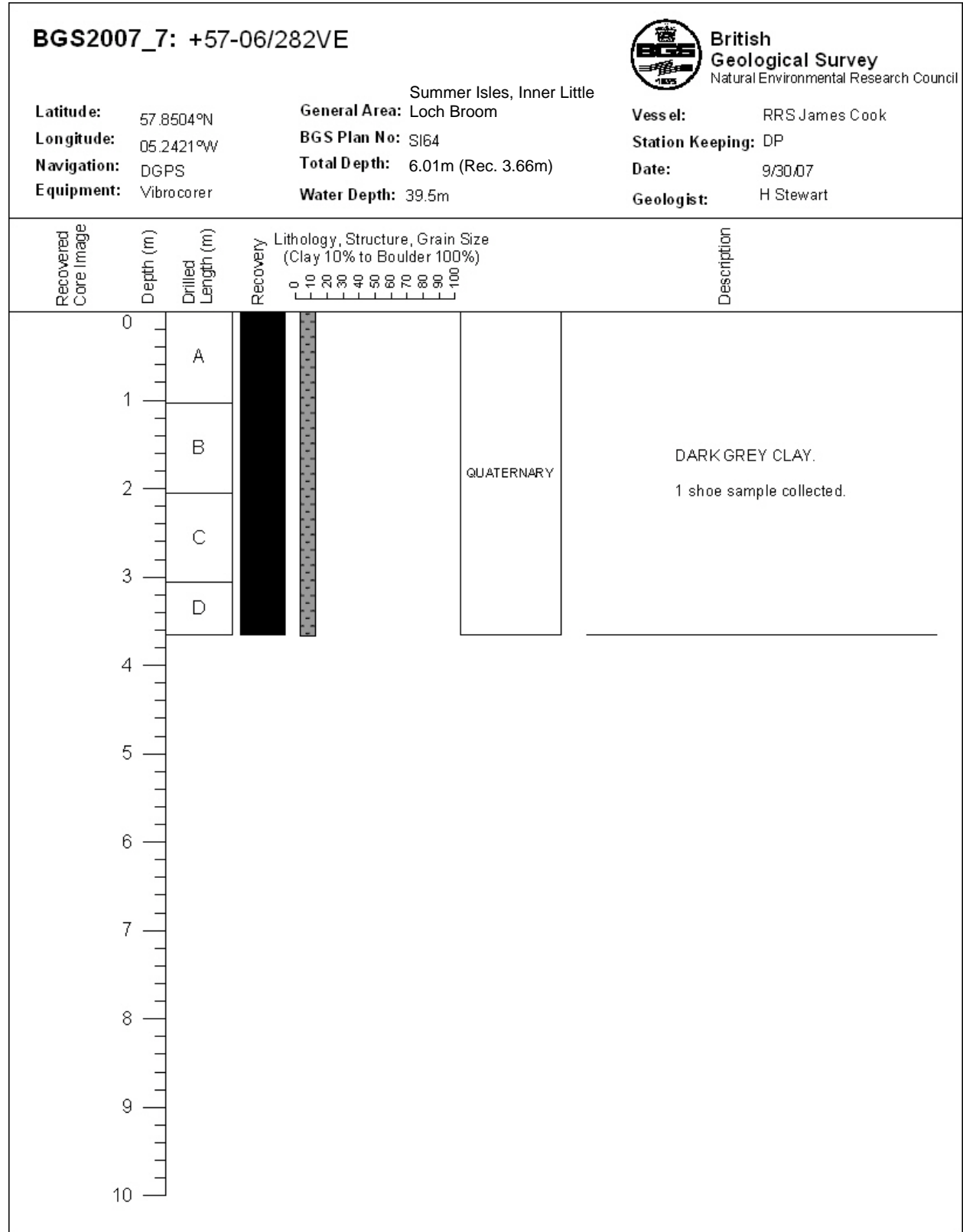
Location Summer Isles, bank between South Priest and Skerries basins



Sample +57-06/282VE

Original Site Number: SI64

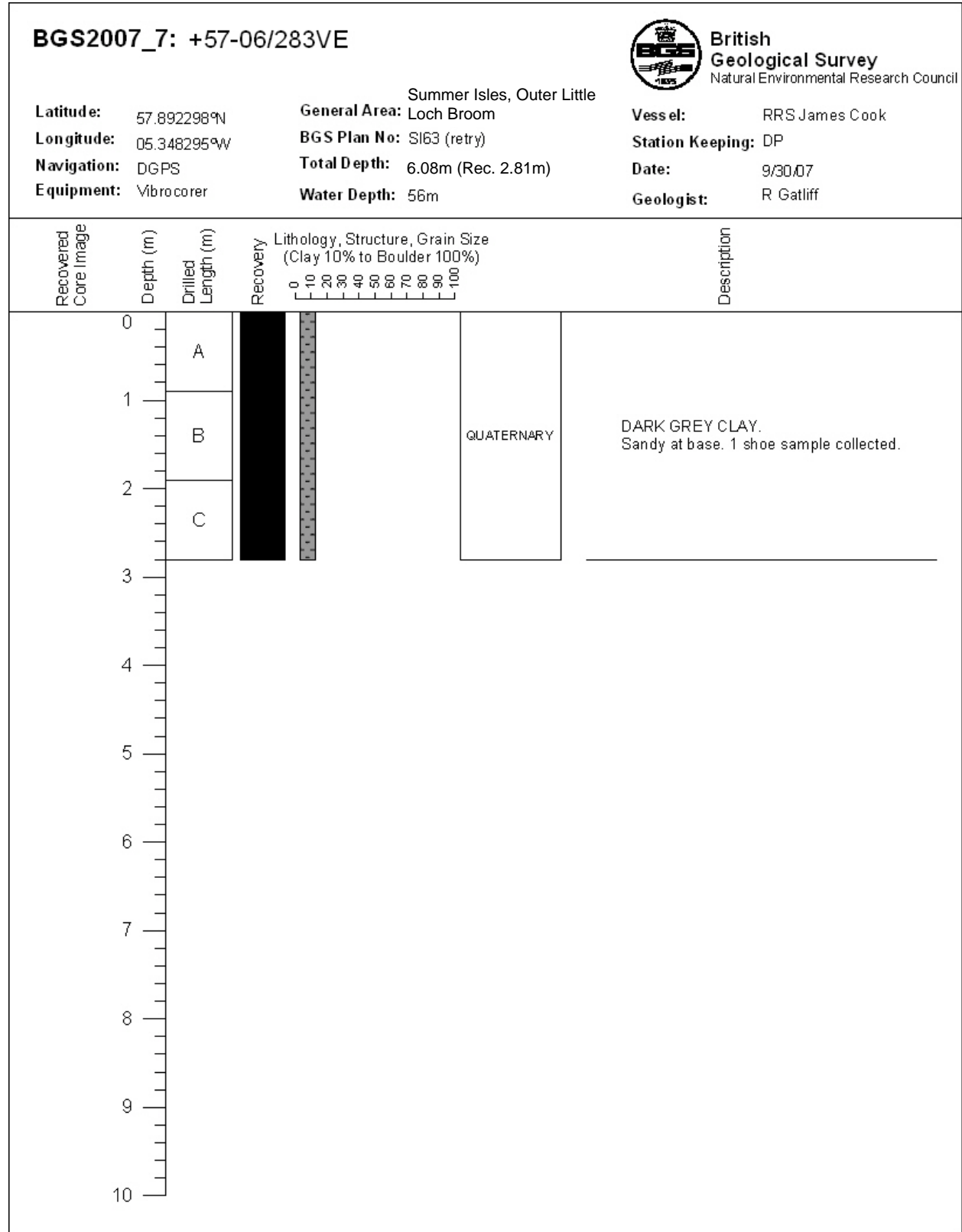
Location Summer Isles, Inner Little Loch Broom



Sample +57-06/283VE

Original Site Number: SI63

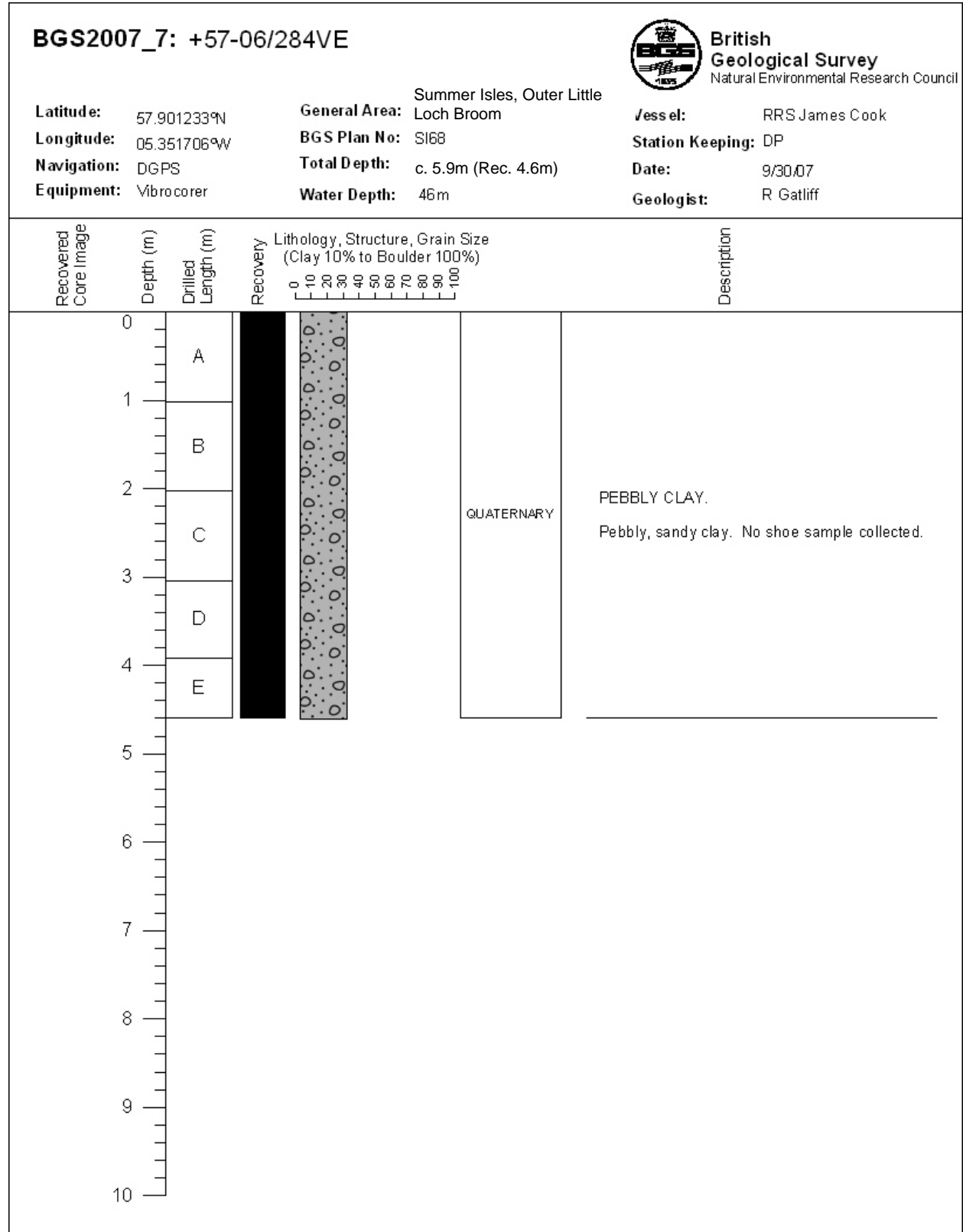
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/284VE

Original Site Number: SI68

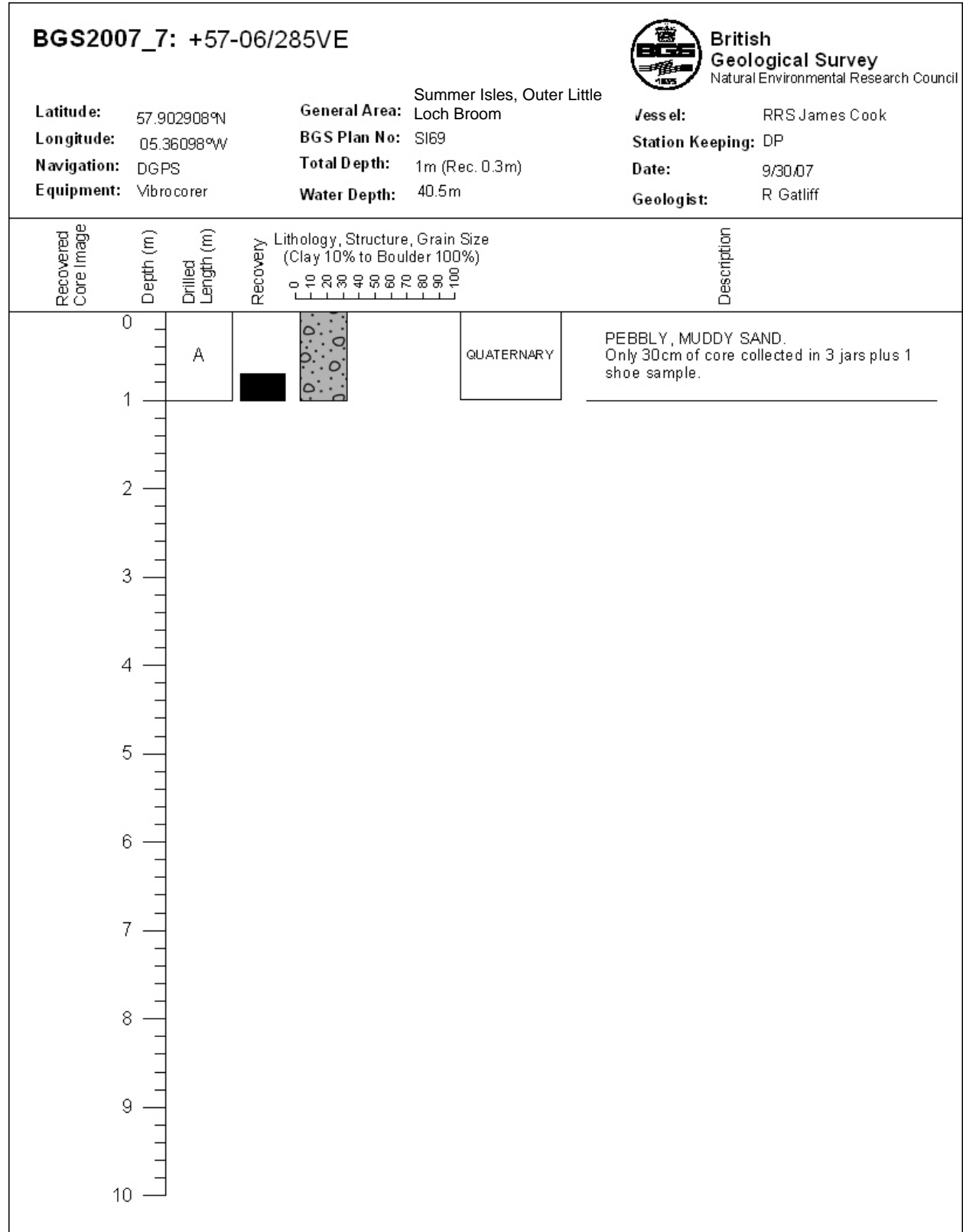
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/285VE

Original Site Number: SI69

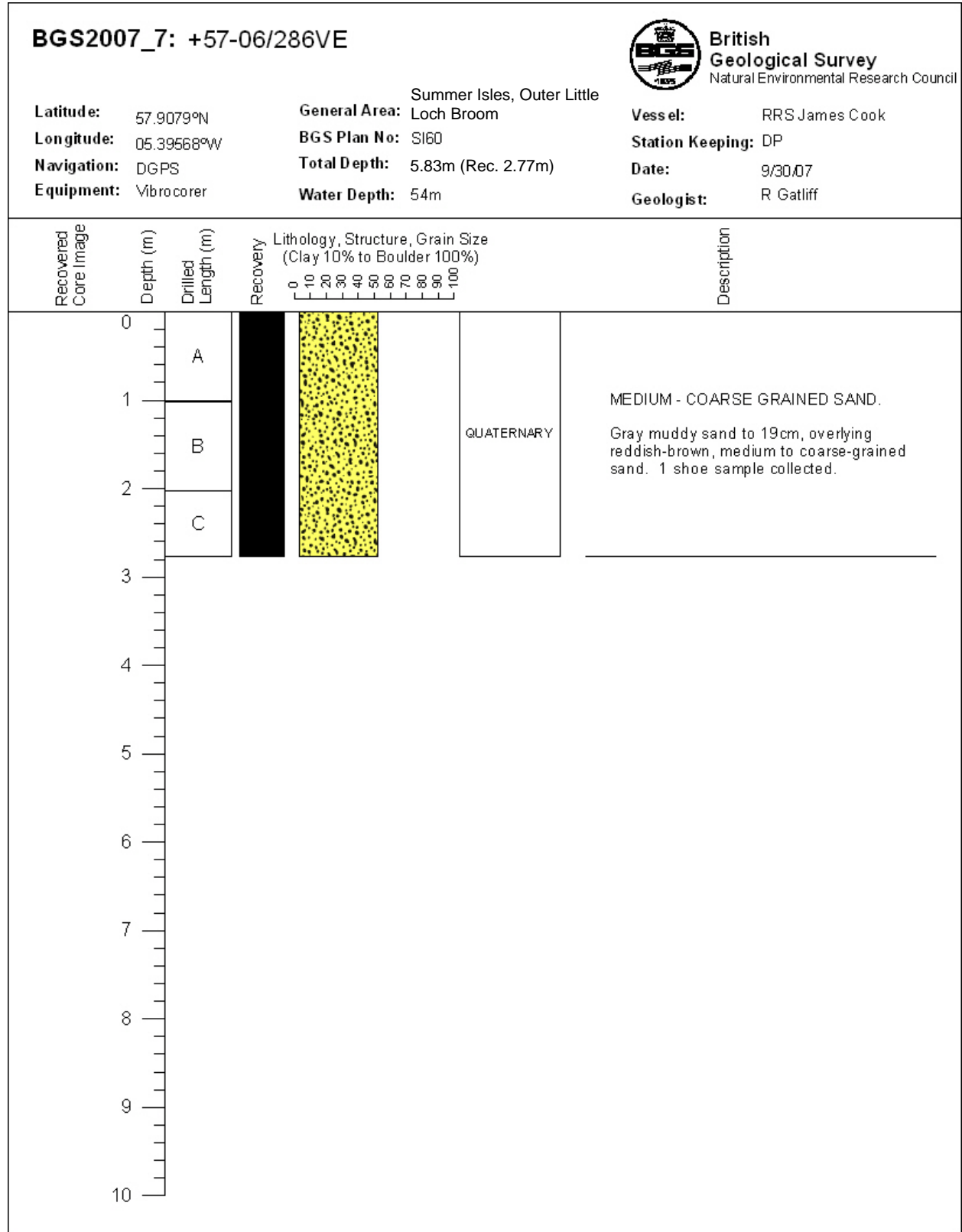
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/286VE

Original Site Number: SI60

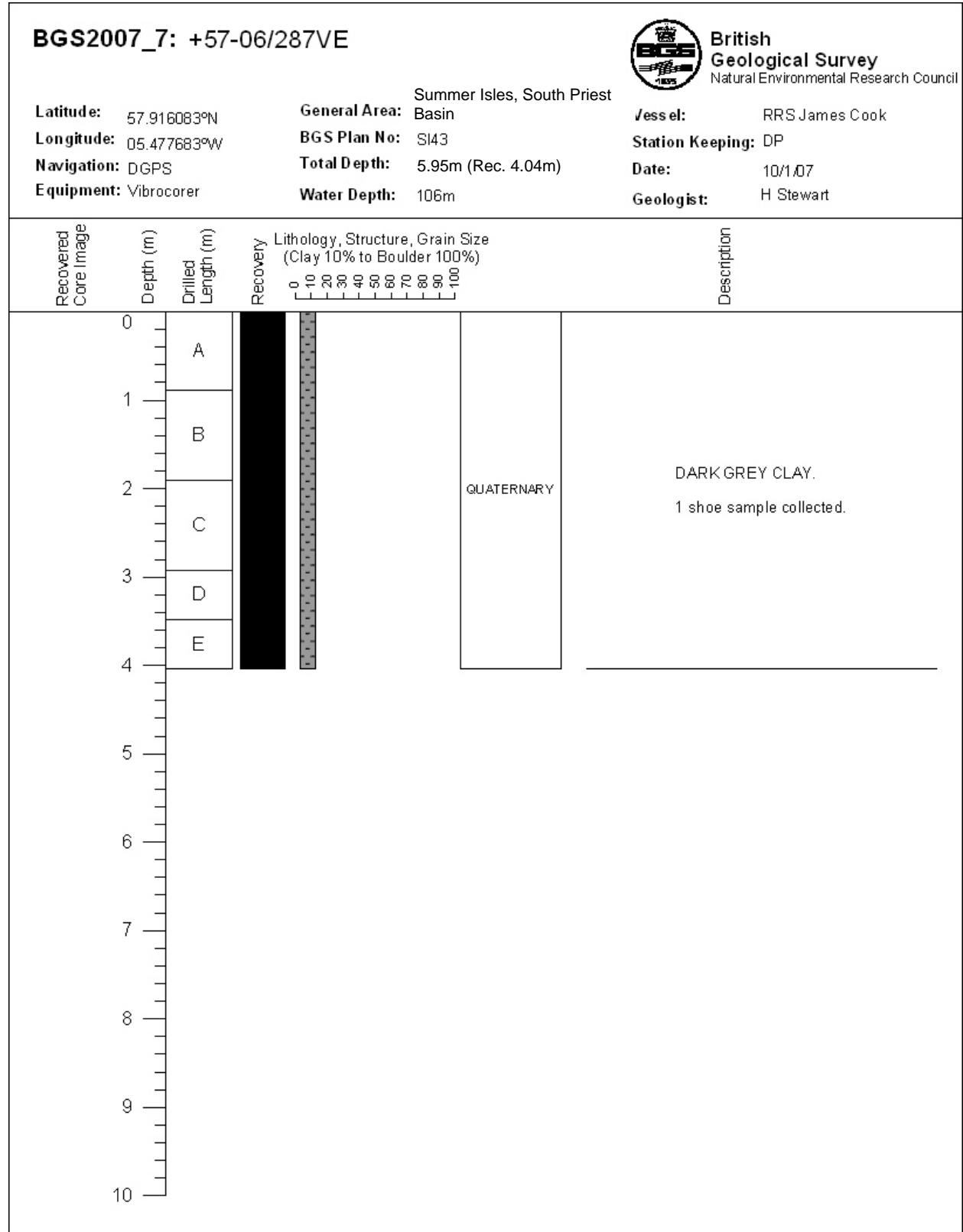
Location Summer Isles, Outer Little Loch Broom



Sample +57-06/287VE

Original Site Number: SI43

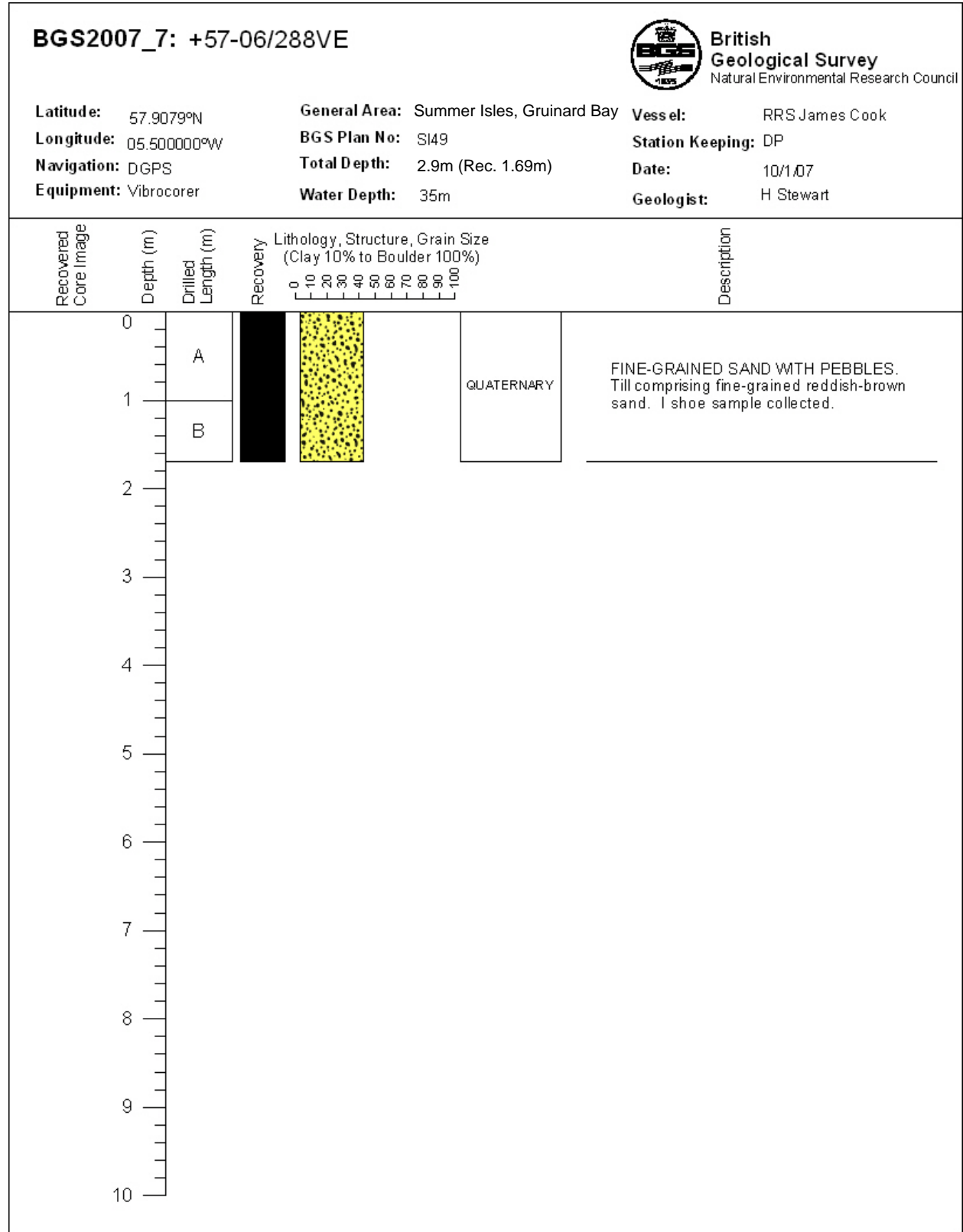
Location Summer Isles, South Priest Basin



Sample +57-06/288VE

Original Site Number: SI49

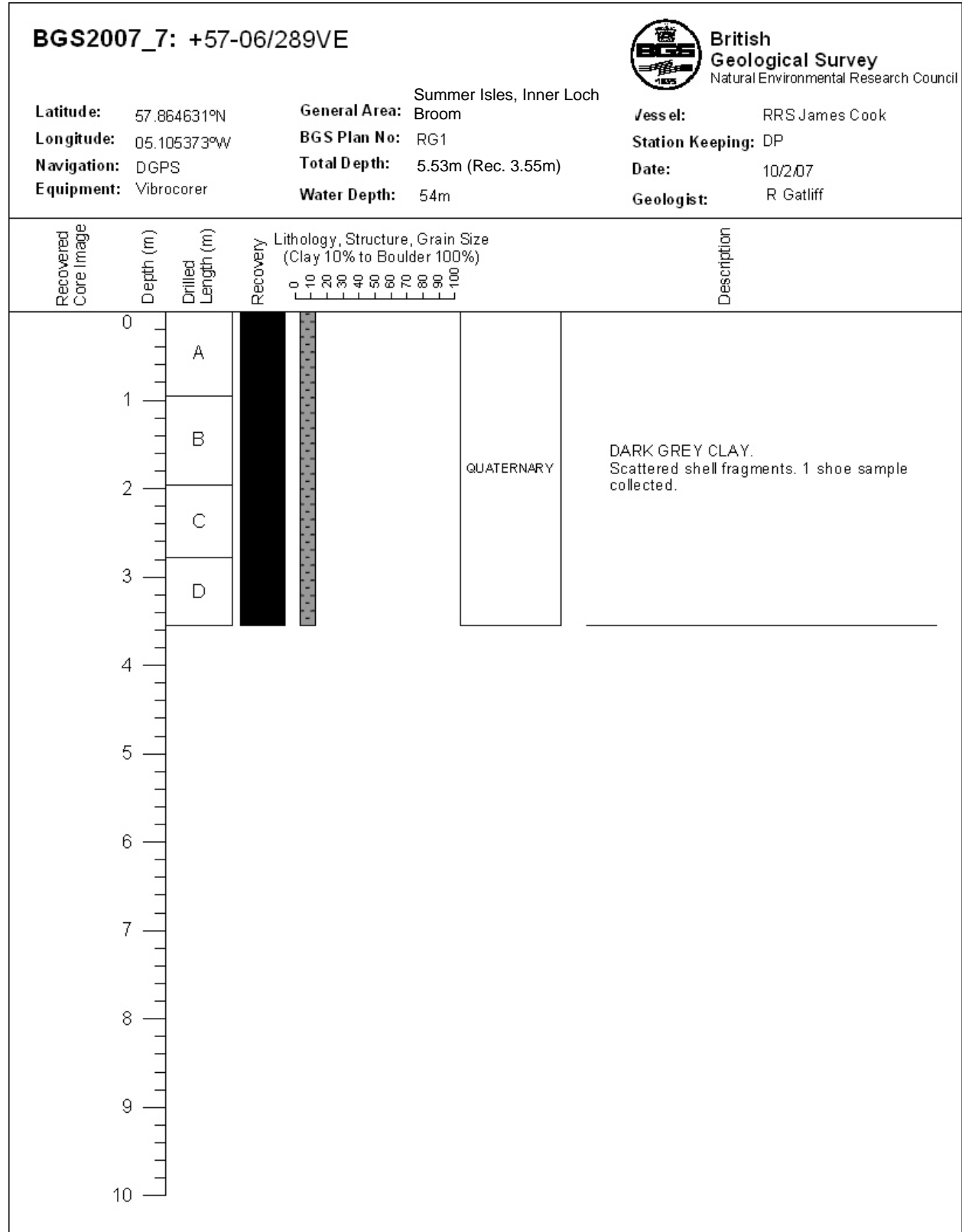
Location Summer Isles, Gruinard Bay



Sample +57-06/289VE

Original Site Number: RG1

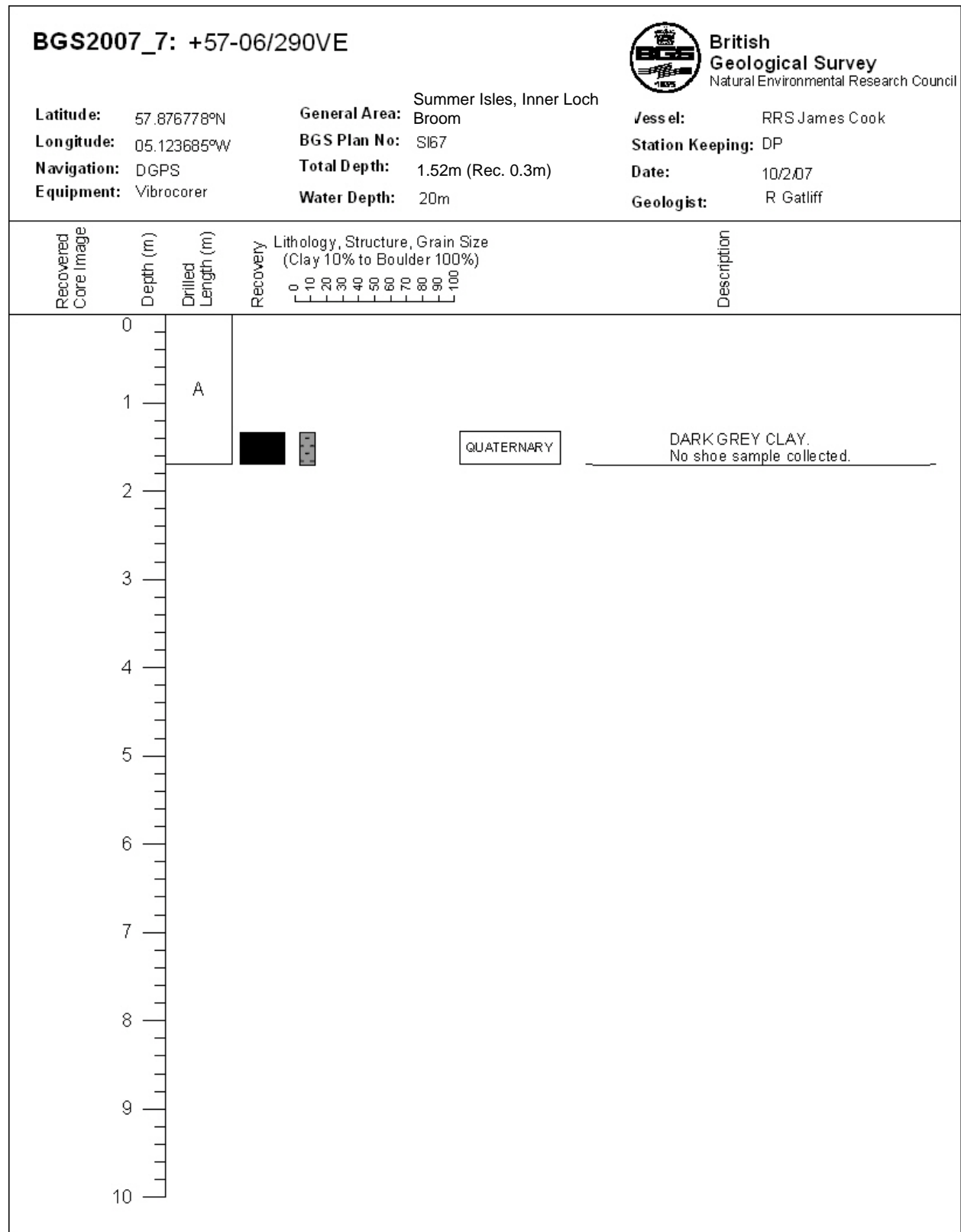
Location Summer Isles, Inner Loch Broom



Sample +57-06/290VE

Original Site Number: SI67

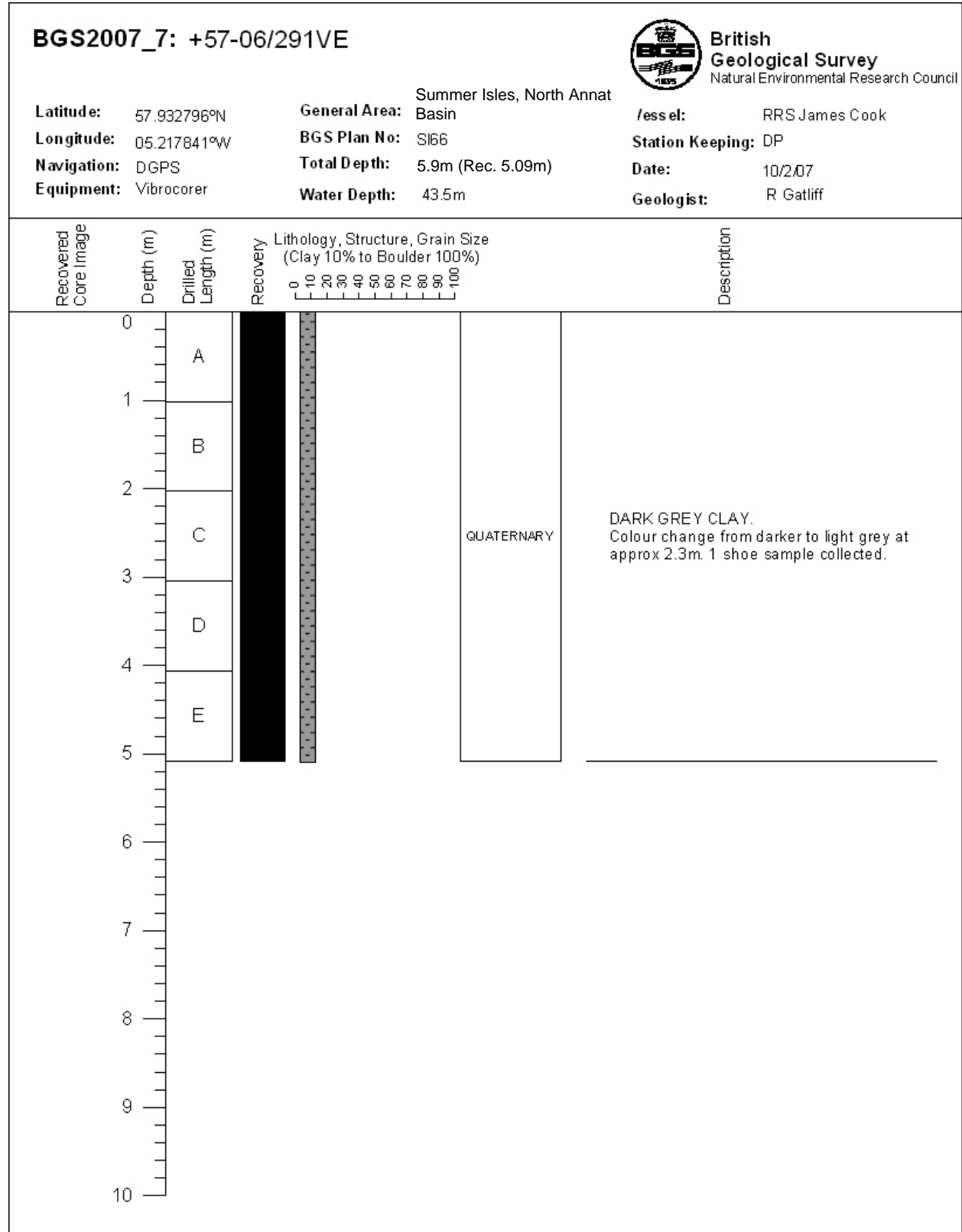
Location Summer Isles, Inner Loch Broom



Sample +57-06/291VE

Original Site Number: SI66

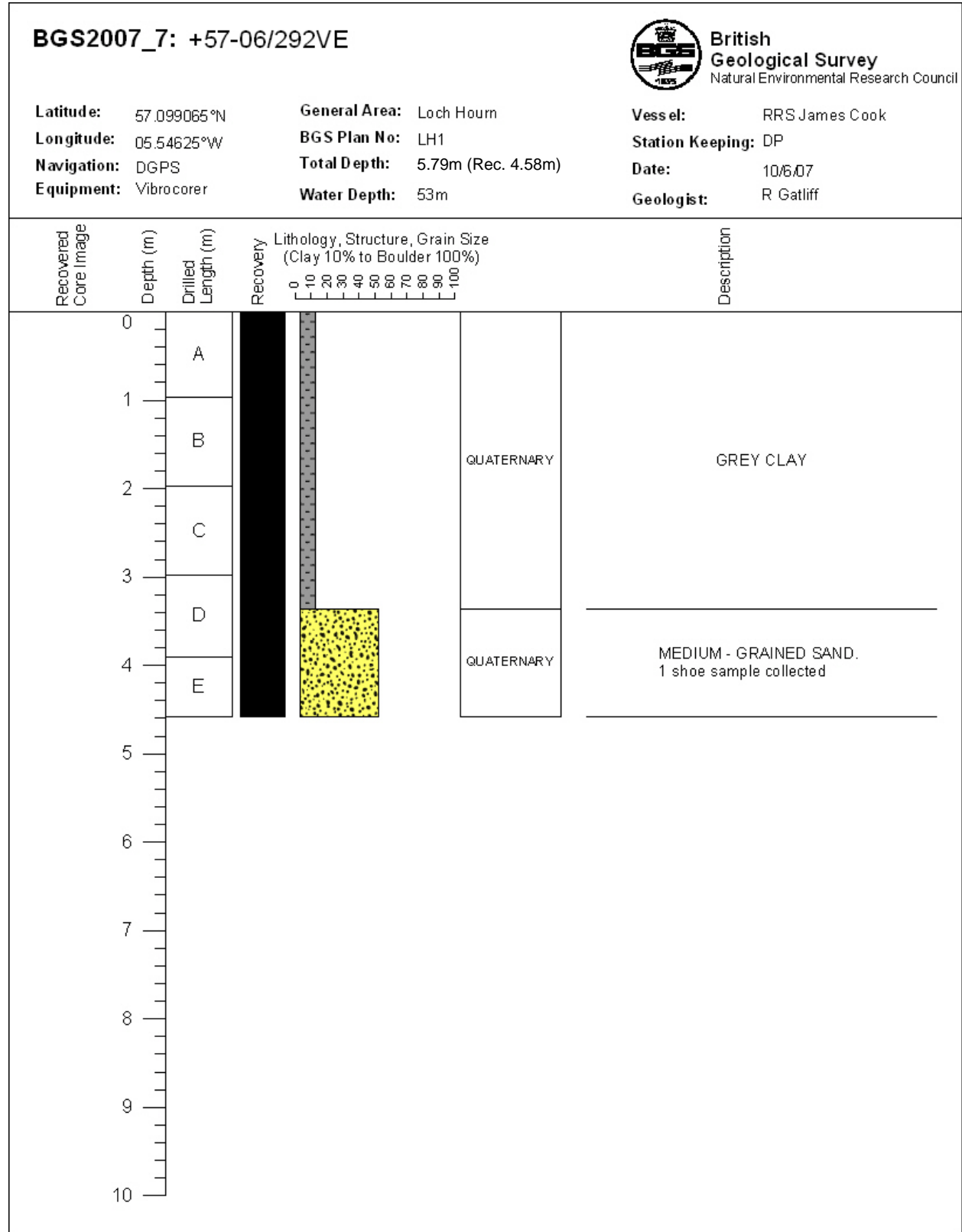
Location Summer Isles, North Annat Basin



Sample +57-06/292VE

Original Site Number: LH1

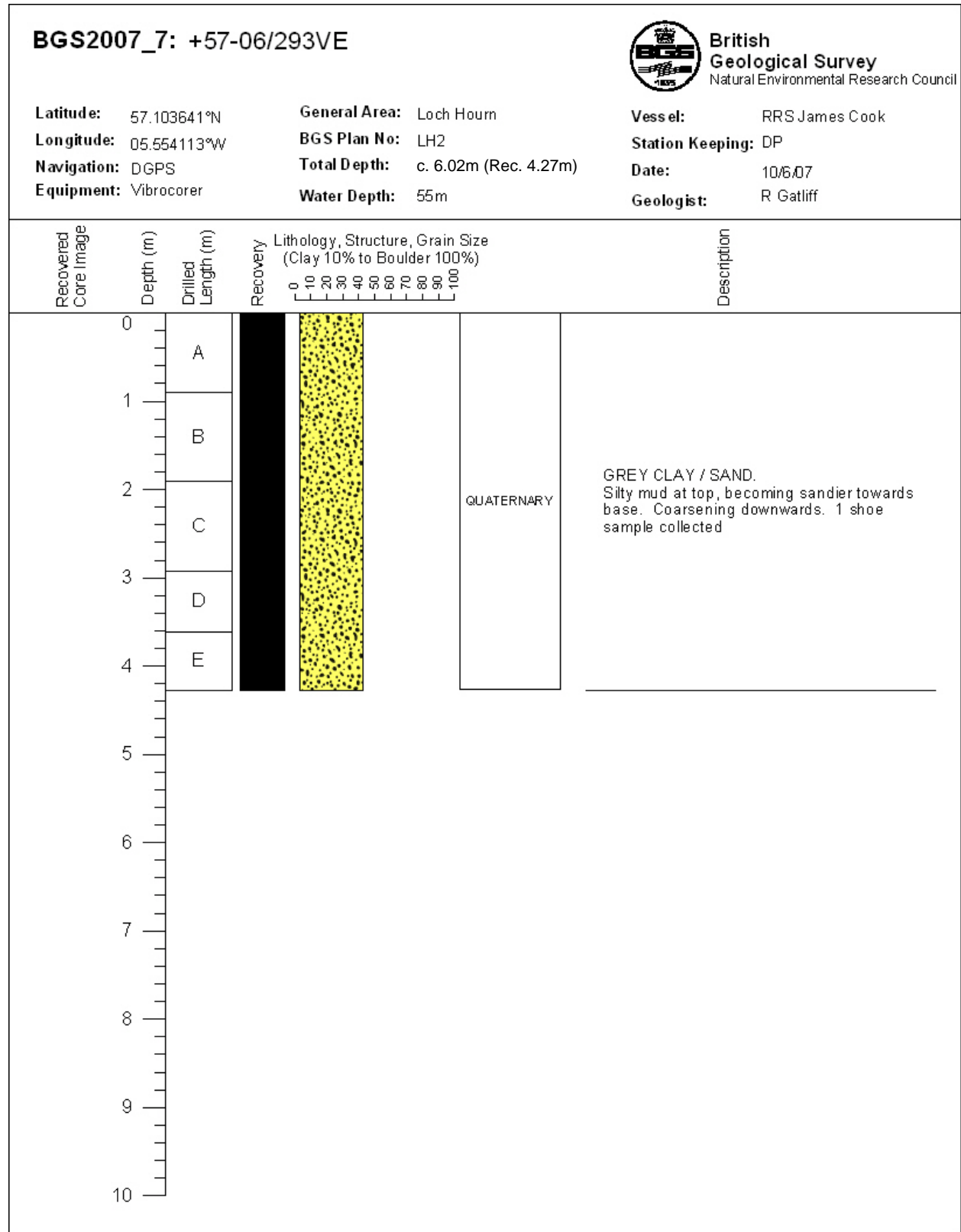
Location Loch Hourn



Sample +57-06/293VE

Original Site Number: LH2

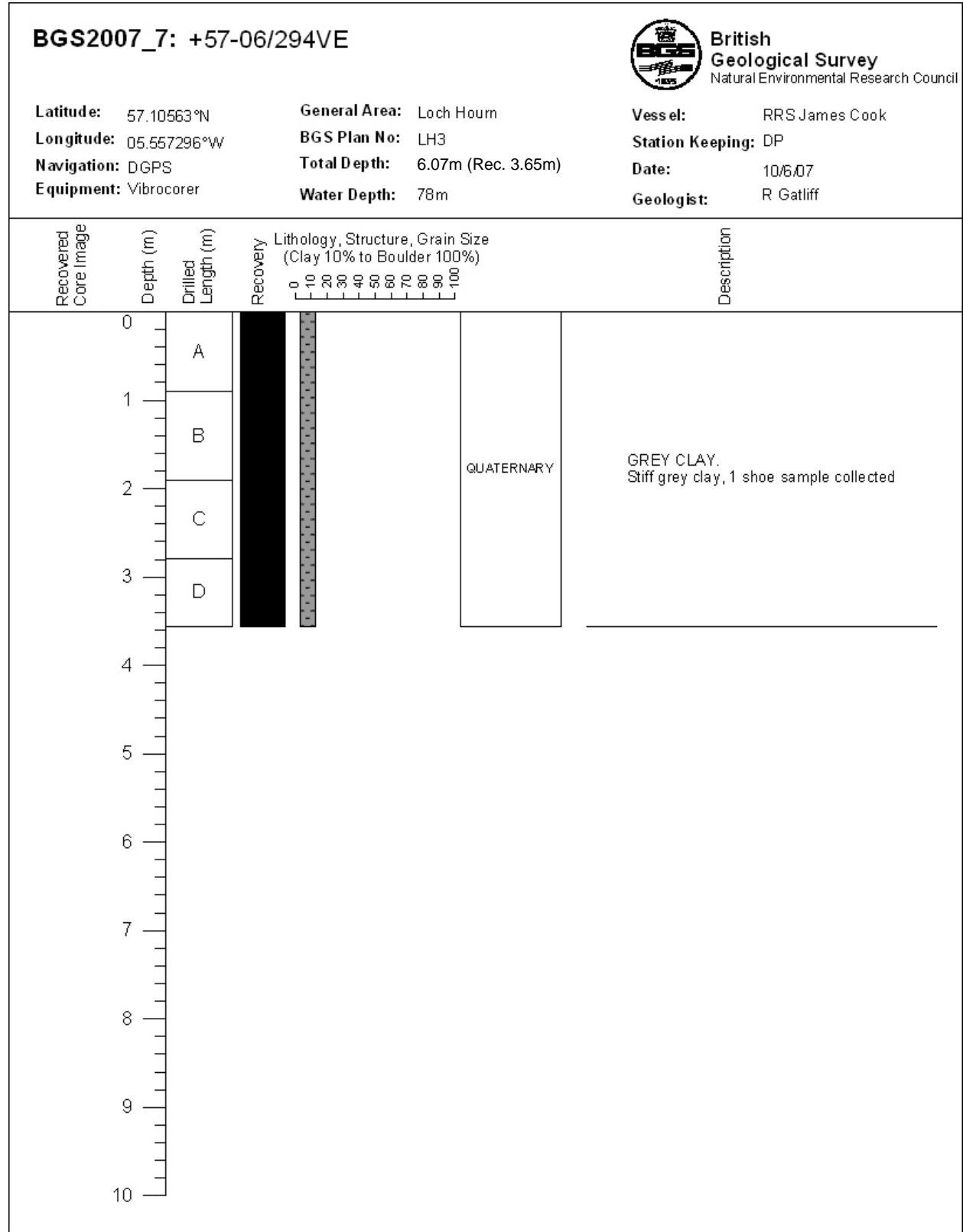
Location Loch Hourn



Sample +57-06/294VE

Original Site Number: LH3

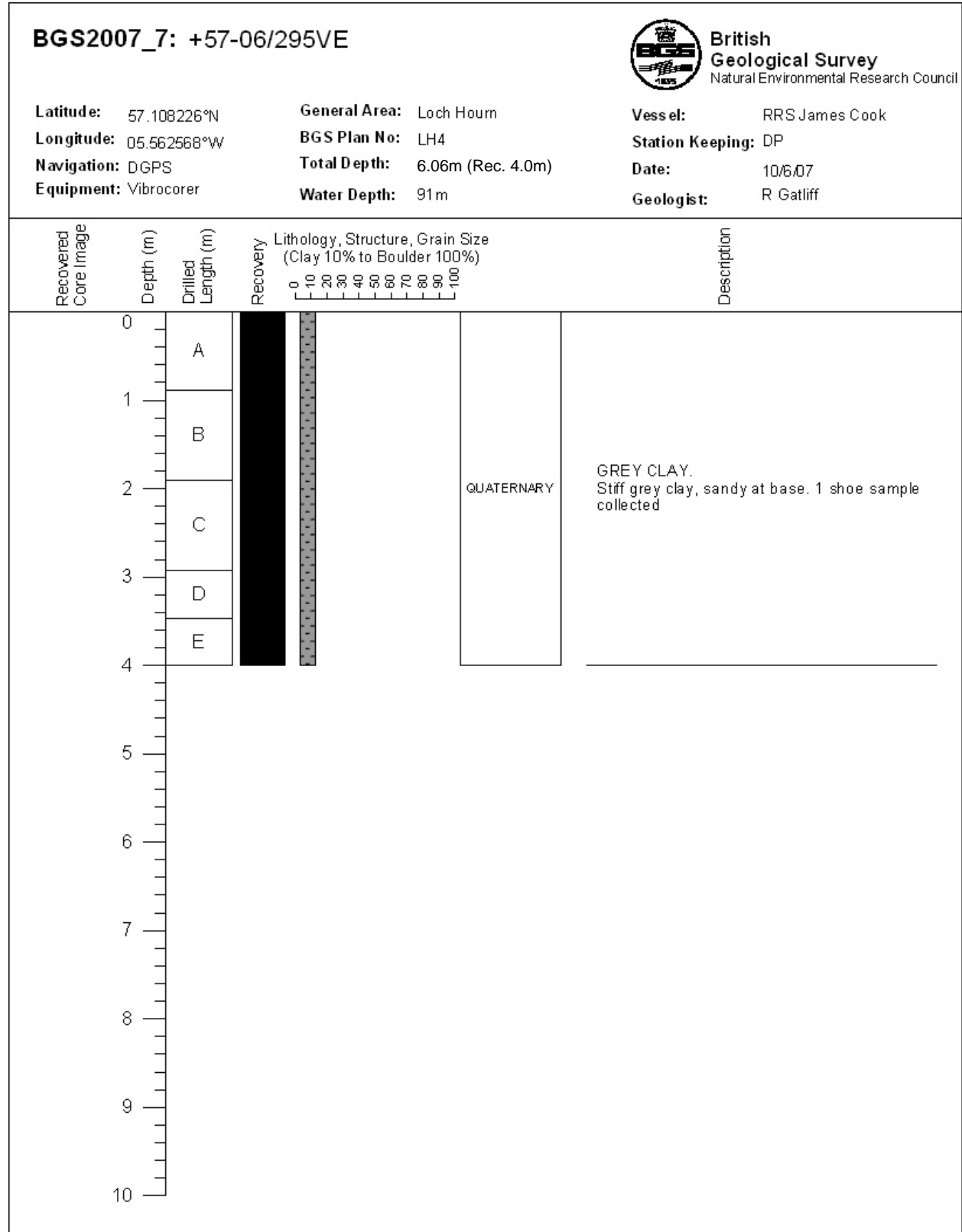
Location Loch Hourn



Sample +57-06/295VE

Original Site Number: LH4

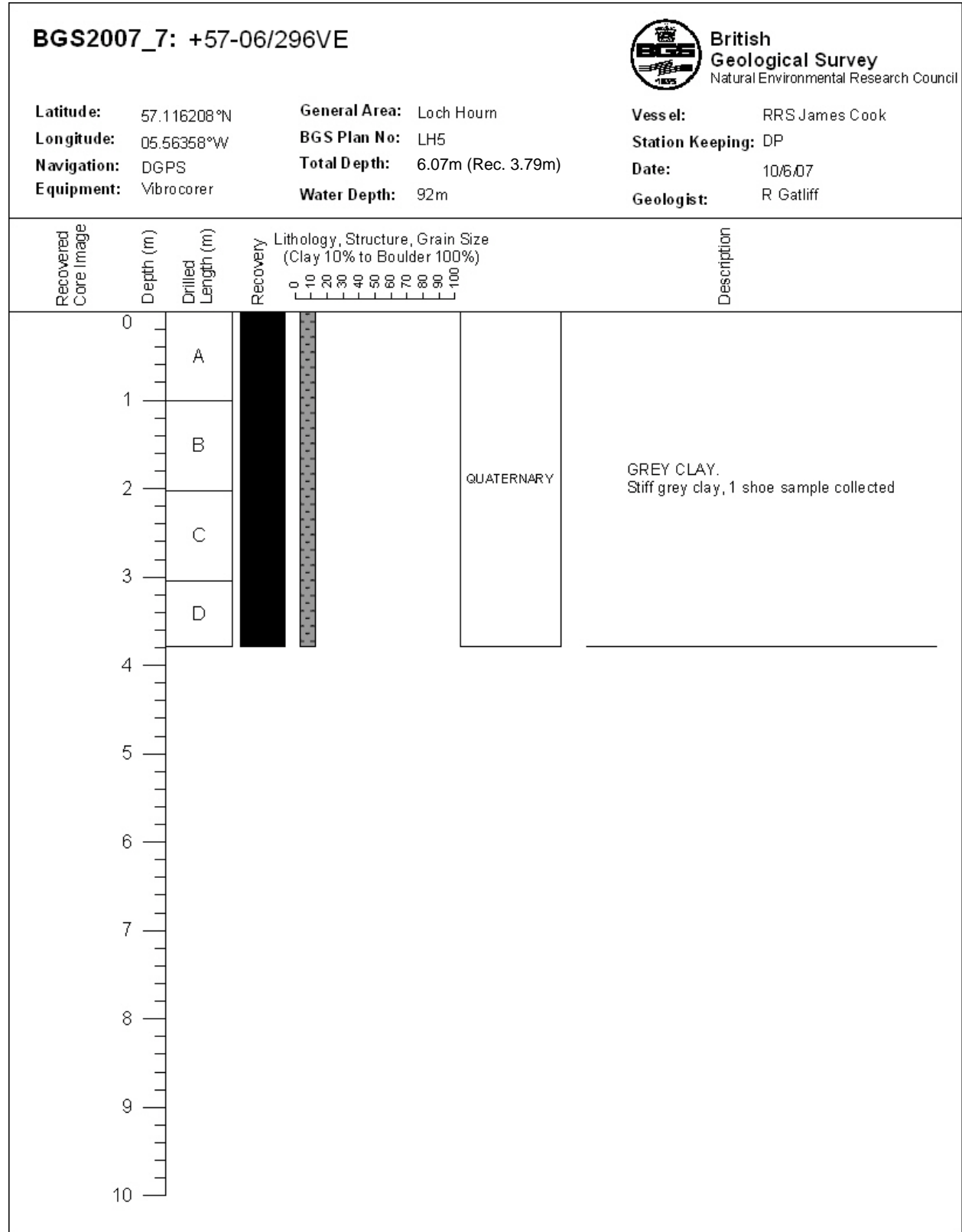
Location Loch Hourn



Sample +57-06/296VE

Original Site Number: LH5

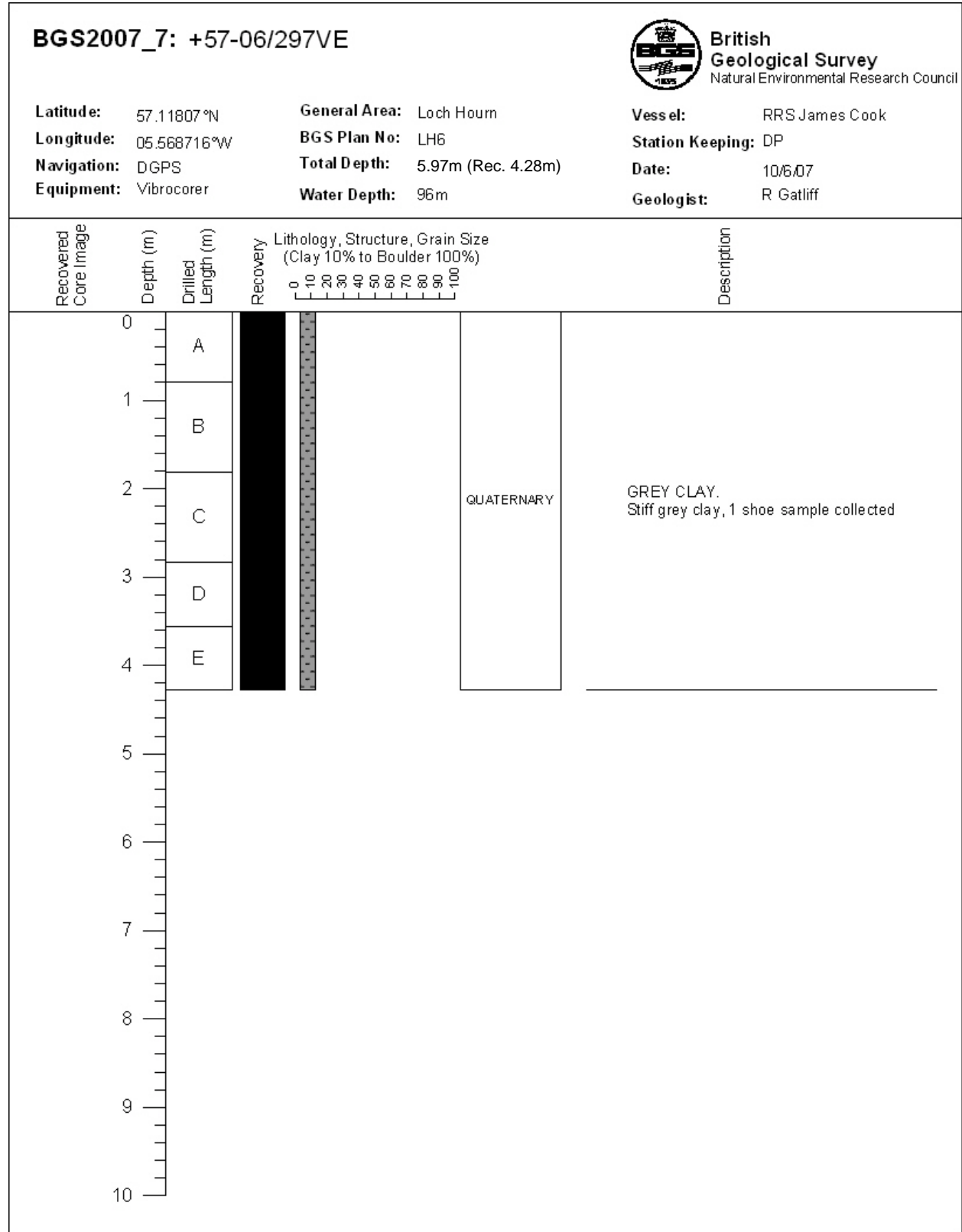
Location Loch Hourn



Sample +57-06/297VE

Original Site Number: LH6

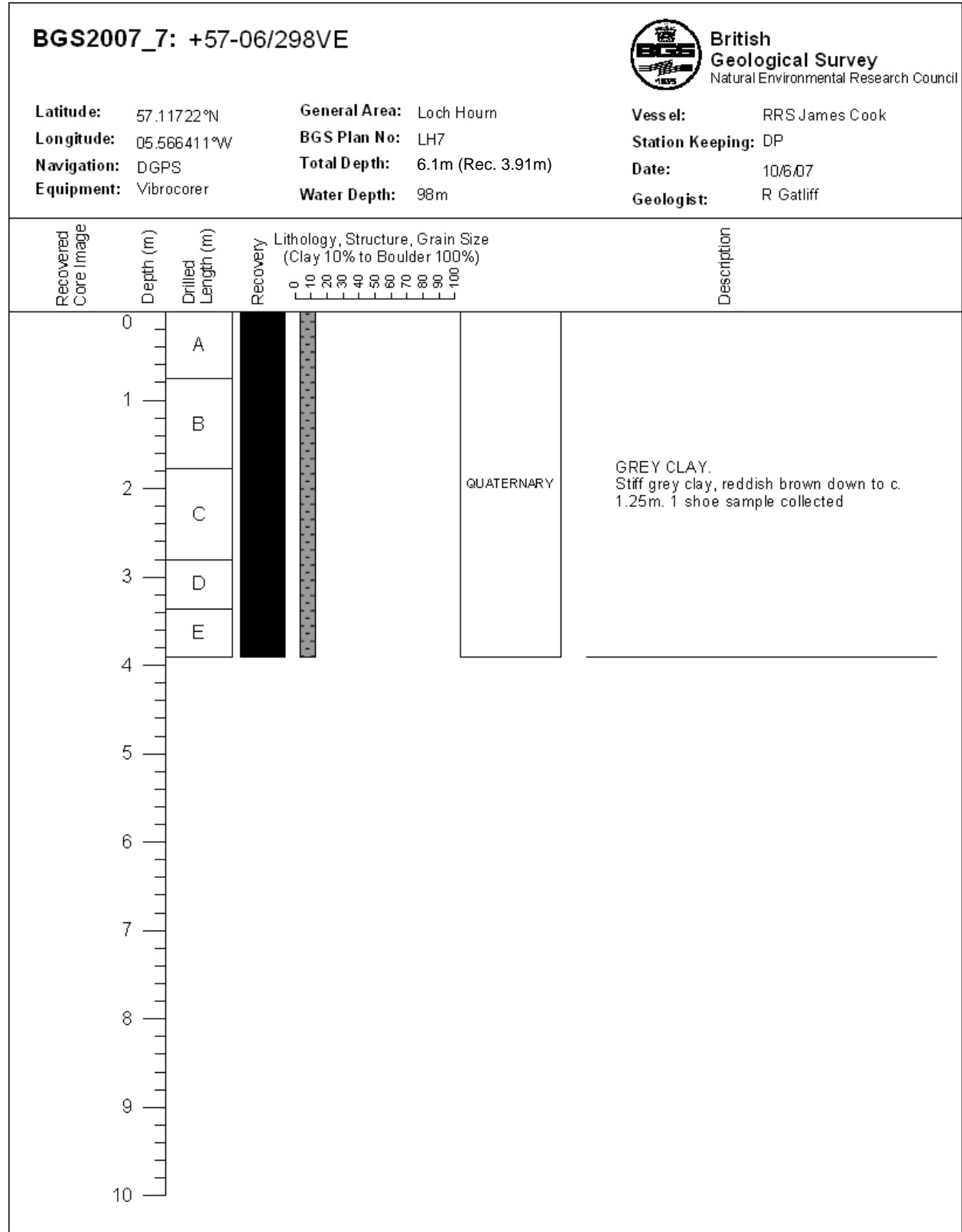
Location Loch Hourn



Sample +57-06/298VE

Original Site Number: LH7

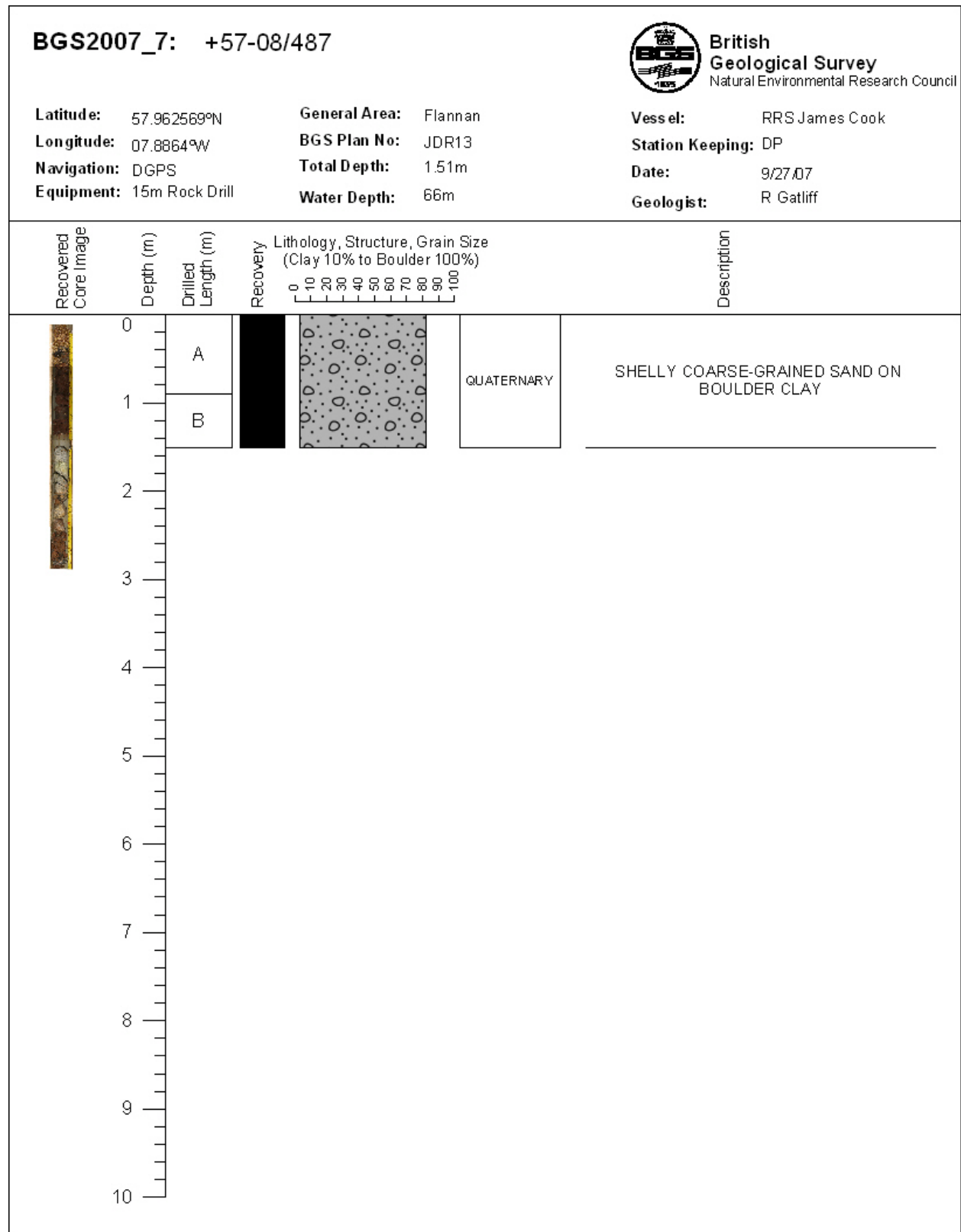
Location Loch Hourn



Sample +57-08/487

Original Site Number: JDR13

Location Flannan



Sample +57-08/487

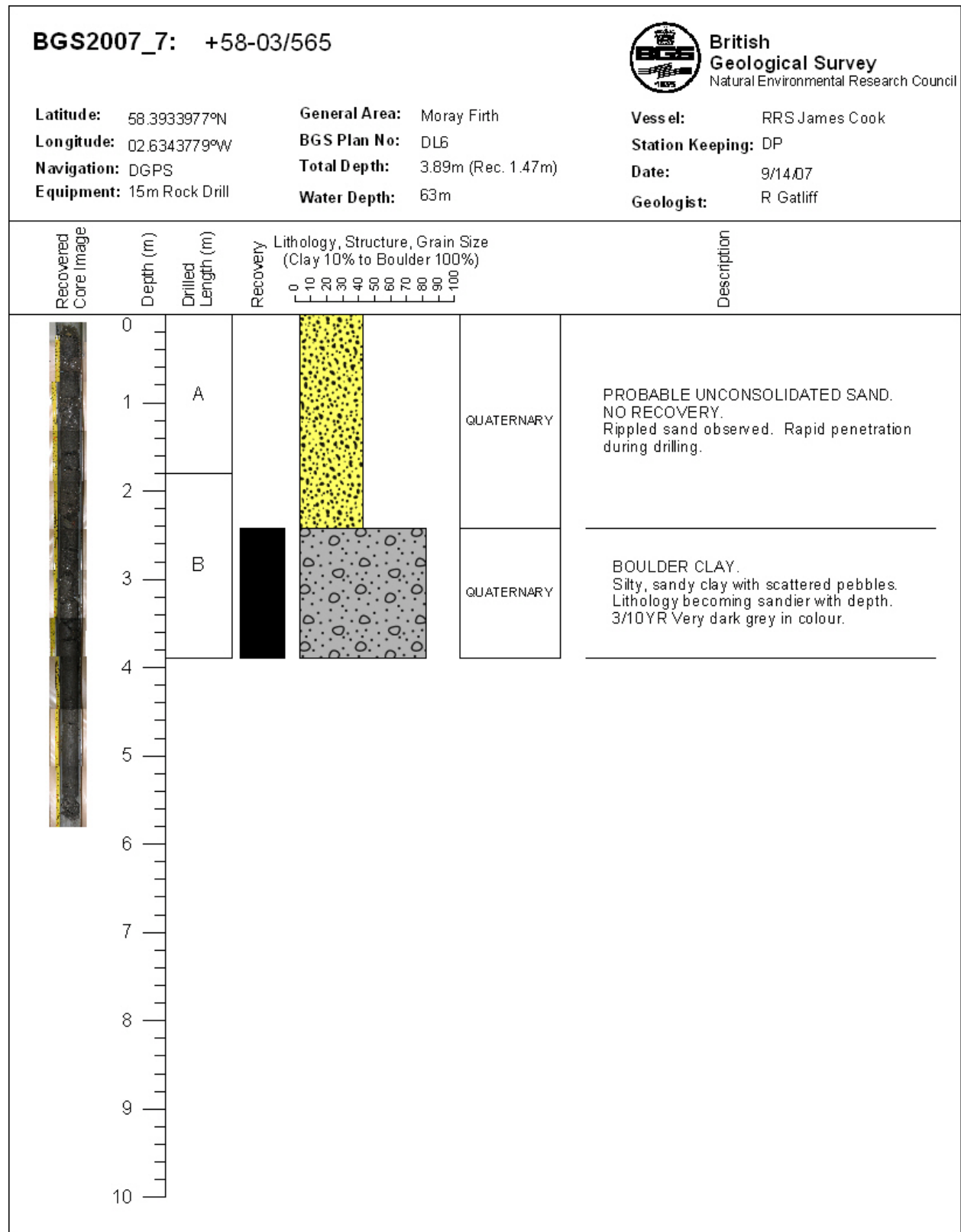
Core photograph



Sample +58-03/565

Original Site Number: DL6

Location Moray Firth, East of Wick



Sample +58-03/565

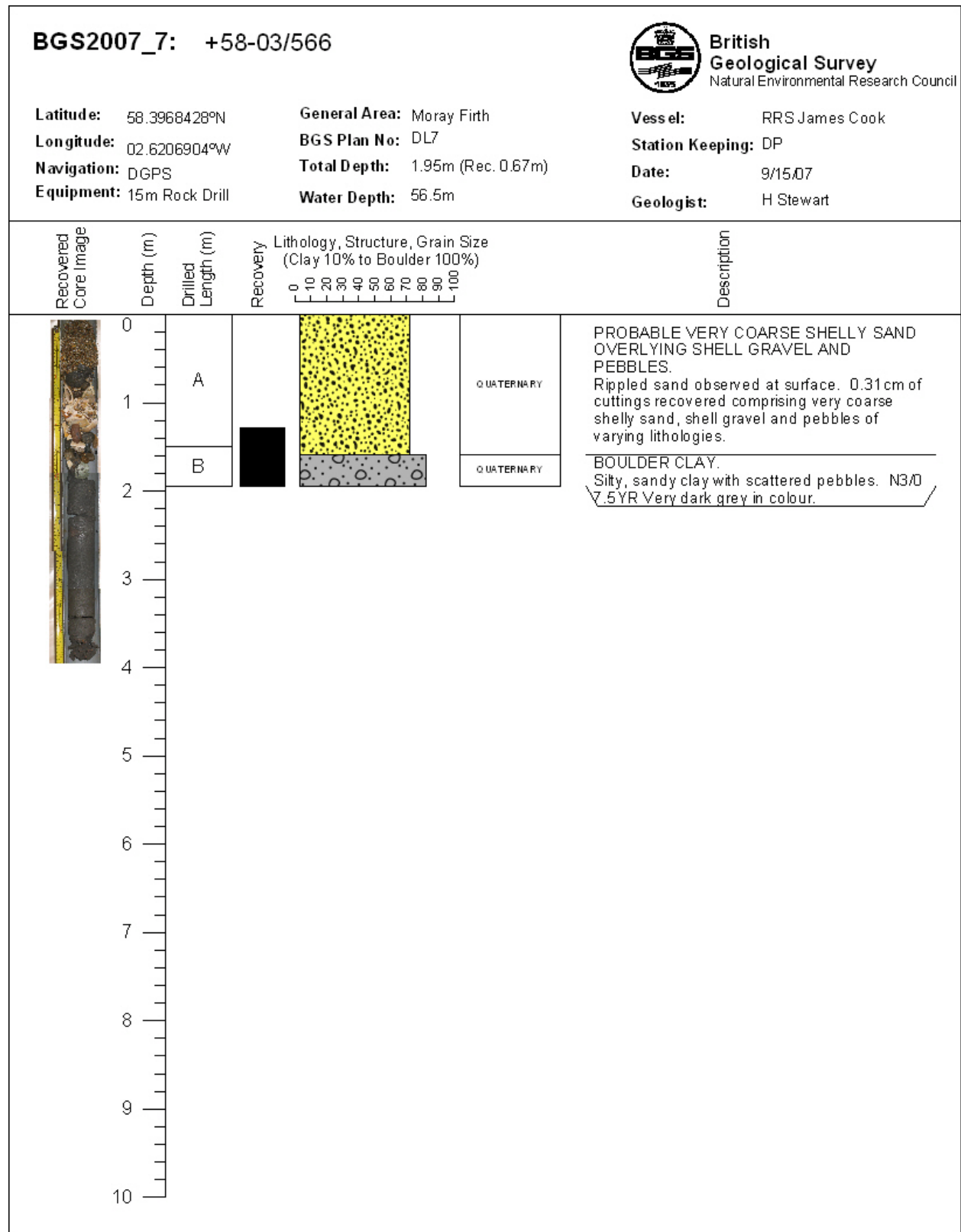
Core photograph



Sample +58-03/566

Original Site Number: DL7

Location Moray Firth, East of Wick



Sample +58-03/566


Core photograph





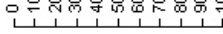


Sample +58-05/389

Original Site Number: JDR3

Location Nun Rock

BGS2007_7: +58-05/389		 British Geological Survey Natural Environmental Research Council	
Latitude: 58.921170°N	General Area: Nun Rock	Vessel: RRS James Cook	
Longitude: 04.99759°W	BGS Plan No: JDR3	Station Keeping: DP	
Navigation: DGPS	Total Depth: 0.79m (Rec. 0.48m)	Date: 10/7/07	
Equipment: 15m Rock Drill	Water Depth: 50.5m	Geologist: H Stewart	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0	A	  		ICE RAFTED COBBLES OF LEWISIAN / CAMBRIAN (?) AGED ROCKS. 5 cobbles sections comprising: 5.5cm diorite, 22.5cm arkose, 4cm quartzite, 11cm quartzite and 5cm of Lewisian(?) gneiss. At the base of the arkose is a thin coarse sand layer.
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
10					

Sample +58-05/389

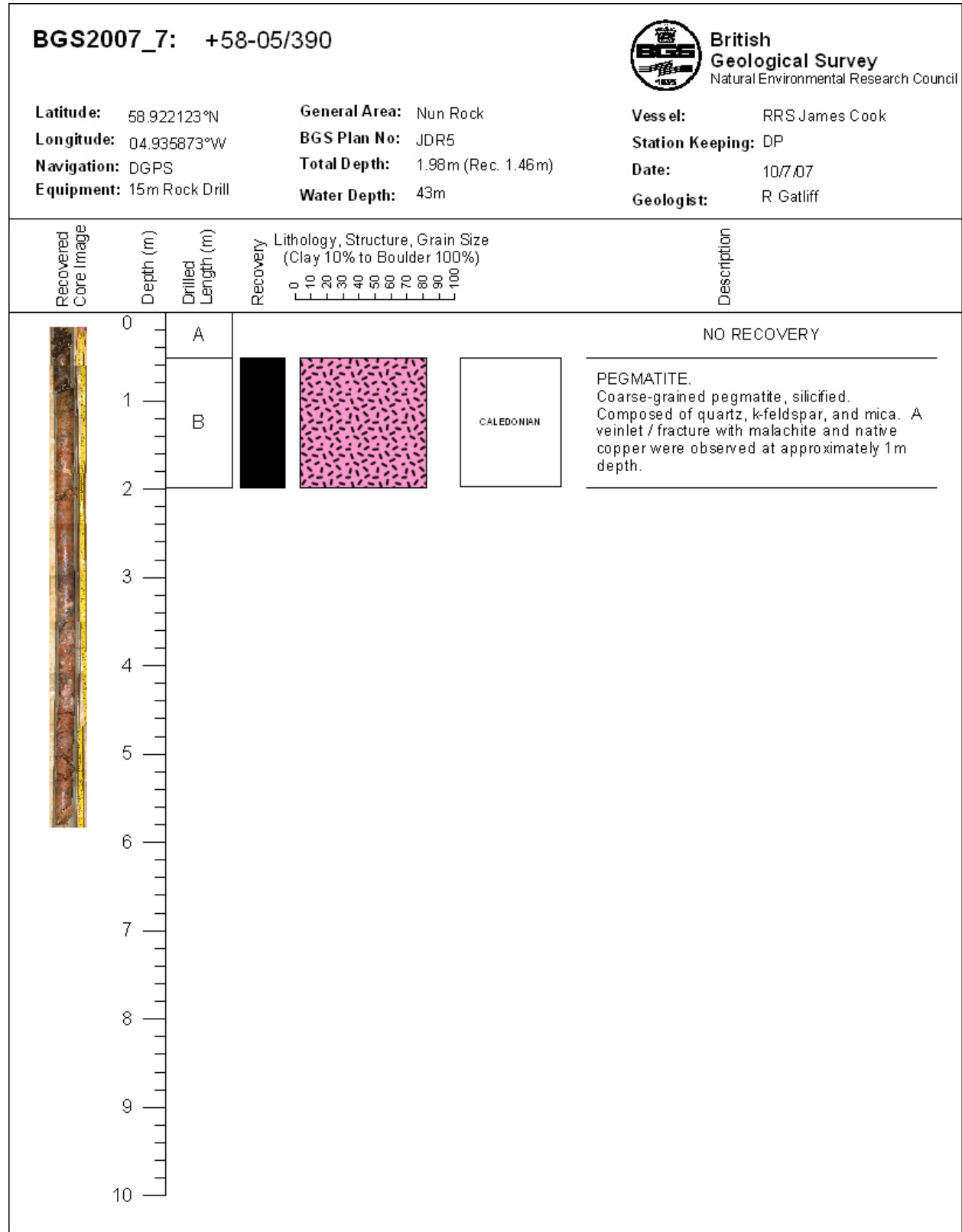
Core photograph



Sample +58-05/390

Original Site Number: JDR5

Location Nun Rock



Sample +58-05/390


Core photograph






Sample +58-05/391

Original Site Number: JDR6

Location Nun Rock

BGS2007_7: +58-05/391		 British Geological Survey Natural Environmental Research Council	
Latitude: 58.98°N	General Area: Nun Rock	Vessel: RRS James Cook	
Longitude: 04.89°W	BGS Plan No: JDR6	Station Keeping: DP	
Navigation: DGPS	Total Depth: 1.3m	Date: 10/7/07	
Equipment: 15m Rock Drill	Water Depth: 50m	Geologist: R Gatliff	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description	
	0				GRANITE. Fine-grained pink granite with quartz, k-feldspar and mica. Vertical fracture in upper 0.85m, with bleaching of feldspars along fracture. Also green alteration minerals lining fracture.	
	1	A				CALEDONIAN
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
10						

Sample +58-05/391


Core photograph




Sample +58-05/392

Original Site Number: JDR14

Location Nun Rock

BGS2007_7: +58-05/392		 British Geological Survey Natural Environmental Research Council	
Latitude: 58.925031°N	General Area: Nun Rock	Vessel: RRS James Cook	
Longitude: 04.969857°W	BGS Plan No: JDR14	Station Keeping: DP	
Navigation: DGPS	Total Depth: 1.6m (Rec. 0.93m)	Date: 10/9/07	
Equipment: 15m Rock Drill	Water Depth: 54m	Geologist: H Stewart	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0	A	■	○	BOULDERS. 2 fragments of glacial boulders in core run 1. Core run 2 recovered a schist cobble which has been significantly weathered into clay (kaolinite?) which retains some fragments of the original rock
	1	B	■	○	
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +58-05/392




Core photograph



Sample +58-05/393

Original Site Number: JDR14

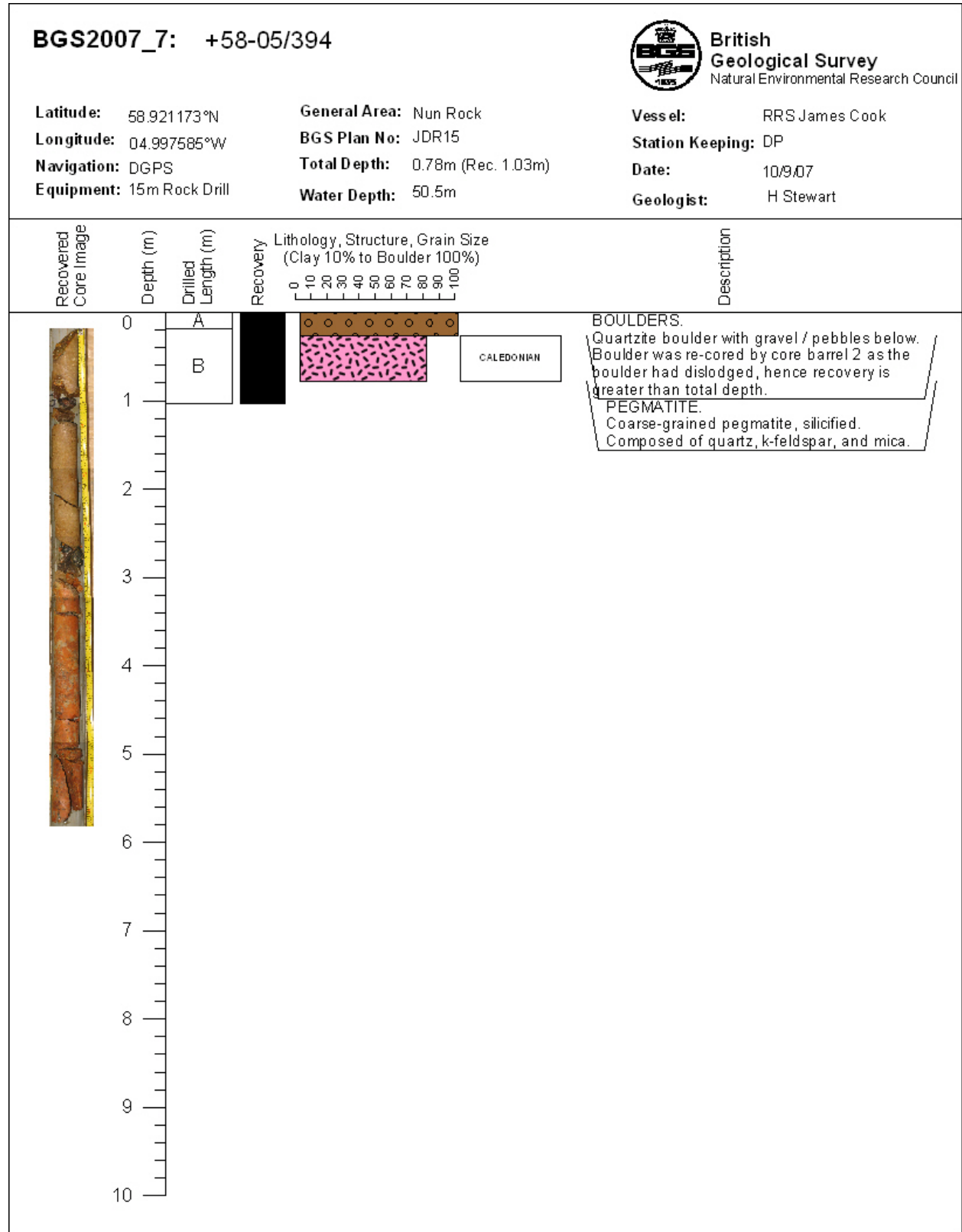
Location Nun Rock

BGS2007_7: +58-05/393		 British Geological Survey Natural Environmental Research Council			
Latitude: 58.925058°N	General Area: Nun Rock	Vessel: RRS James Cook			
Longitude: 04.970093°W	BGS Plan No: JDR14B	Station Keeping: DP			
Navigation: DGPS	Total Depth: 0.44m	Date: 10/9/07			
Equipment: 15m Rock Drill	Water Depth: 52m	Geologist: H Stewart			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0	A		 LEWISIAN	BANDED GNEISS. Recovered a number of fractured pieces of banded gneiss varying in size from 2 - 6cm in length. Hard to determine whether in-situ or glacial erratic.
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
10					

Sample +58-05/394

Original Site Number: JDR15

Location Nun Rock



Sample +58-05/394


Core photograph






Sample +58-05/395

Original Site Number: JDR17

Location Nun Rock

BGS2007_7: +58-05/395		 British Geological Survey Natural Environmental Research Council	
Latitude: 58.976429°N	General Area: Nun Rock	Vessel: RRS James Cook	
Longitude: 04.923643°W	BGS Plan No: JDR17	Station Keeping: DP	
Navigation: DGPS	Total Depth: 1.39m (Rec. 1.39m)	Date: 10/9/07	
Equipment: 15m Rock Drill	Water Depth: 51m	Geologist: H Stewart	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				
	1	A			LEWISIAN BANDED GNEISS with numerous veins along which it preferentially fractures
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
10					

Sample +58-05/395

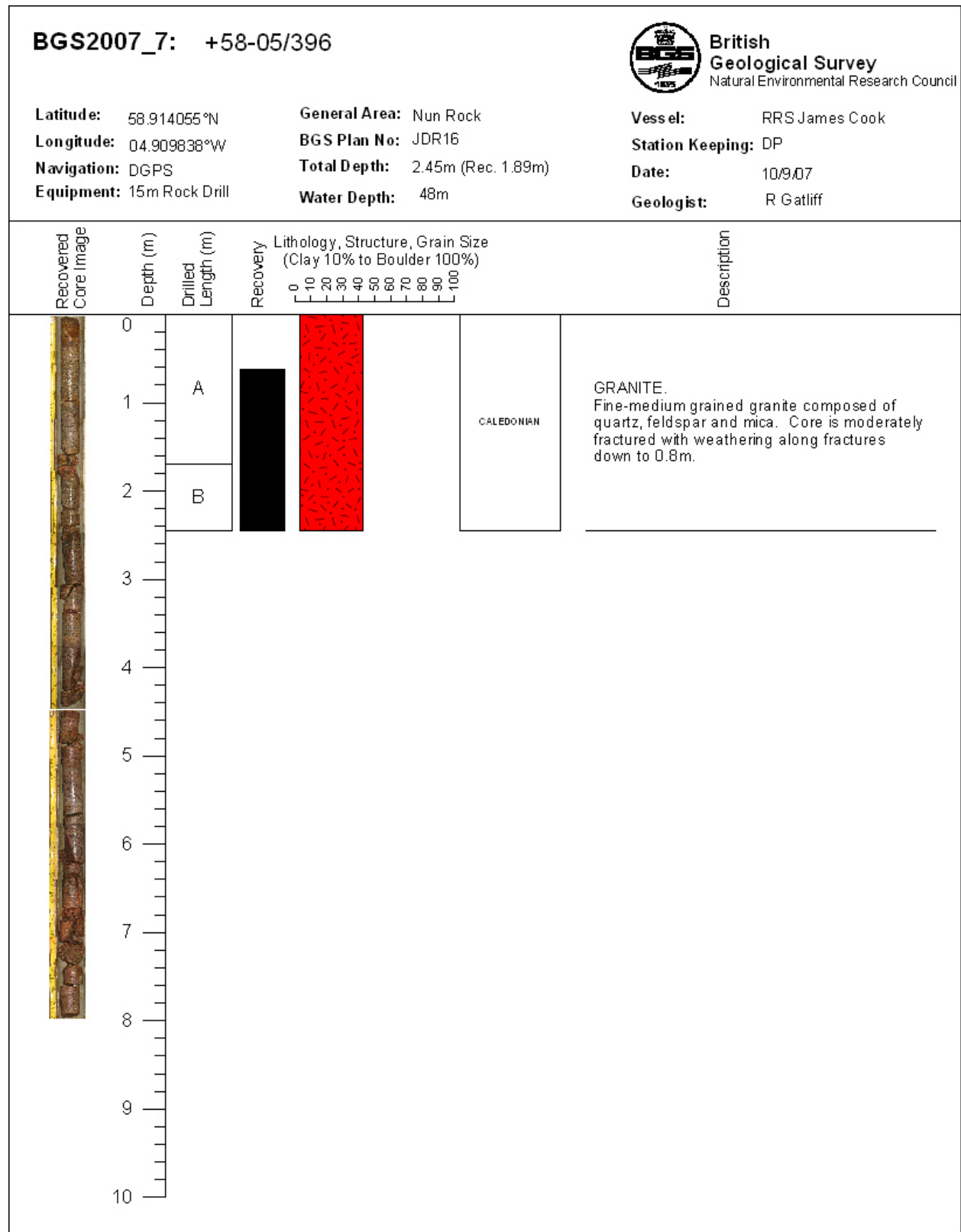
Core photograph



Sample +58-05/396

Original Site Number: JDR16

Location Nun Rock



Sample +58-05/396





Core photograph



Sample +58-05/397

Original Site Number: JDR4

Location Nun Rock

BGS2007_7: +58-05/397		 British Geological Survey Natural Environmental Research Council				
Latitude: 58.887661°N	General Area: Nun Rock	Vessel: RRS James Cook				
Longitude: 04.952161°W	BGS Plan No: JDR4	Station Keeping: DP				
Navigation: DGPS	Total Depth: 1.27m (Rec. 1.16m)	Date: 10/9/07				
Equipment: 15m Rock Drill	Water Depth: 33m	Geologist: R Gatliff				
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description	
	0					
	1	A			<div style="border: 1px solid black; padding: 2px; display: inline-block;"> CALEDONIAN </div>	META-DIORITE? Medium to fine grained, quartz-mica schistose metamorphic rock. Strong fabric dipping at c. 30 degrees to core. A 10mm quartz vein at 0.82m dips at c. 60 degrees to core.
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
10						

Sample +58-05/397

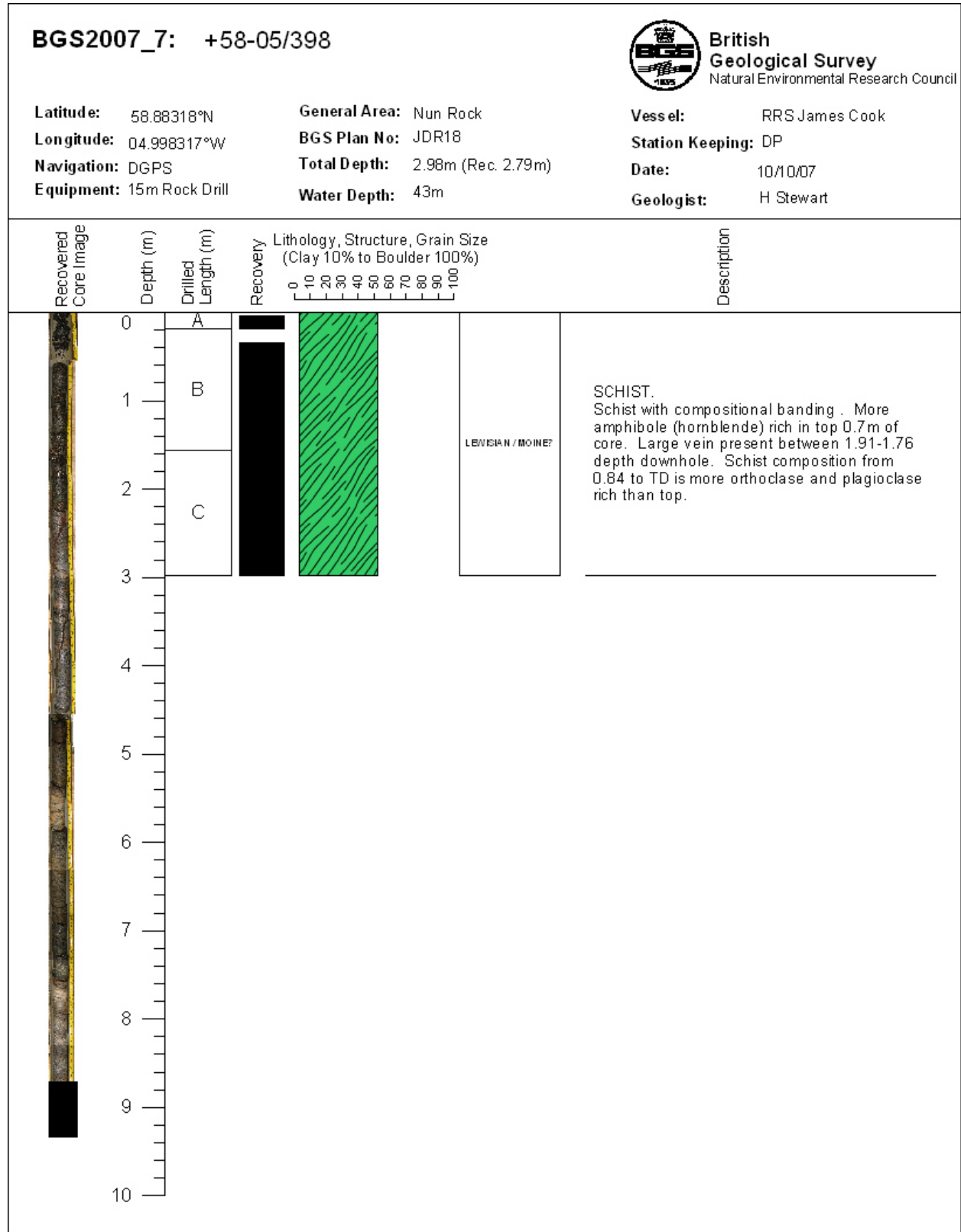
Core photograph



Sample +58-05/398

Original Site Number: JDR18

Location Nun Rock



Sample +58-05/398


Core photograph



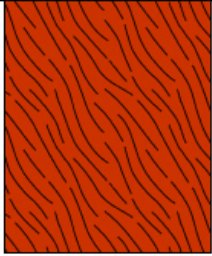


Sample +58-08/231

Original Site Number: JDR11

Location Flannan

BGS2007_7: +58-08/231		 British Geological Survey Natural Environmental Research Council	
Latitude: 58.0537°N	General Area: Flannan	Vessel: RRS James Cook	
Longitude: 07.8356°W	BGS Plan No: JDR11	Station Keeping: DP	
Navigation: DGPS	Total Depth: 2.18m	Date: 9/28/07	
Equipment: 15m Rock Drill	Water Depth: 49.5m	Geologist: R Gatliff	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0 1 2 3 4 5 6 7 8 9 10	A		 LEWISIAN	GRANITIC GNEISS. Weakly foliated granitic gneiss / granodiorite with quartz, feldspar, biotite and ?amphibole

Sample +58-08/231


Core photograph








Sample +59-05/317

Original Site Number: JDR7

Location Nun Rock

BGS2007_7: +59-05/317		 British Geological Survey Natural Environmental Research Council	
Latitude: 59.076954°N	General Area: Nun Rock	Vessel: RRS James Cook	
Longitude: 04.890199°W	BGS Plan No: JDR7	Station Keeping: DP	
Navigation: DGPS	Total Depth: 2.66m (Rec. 2.13m)	Date: 10/10/07	
Equipment: 15m Rock Drill	Water Depth: 51.5m	Geologist: H Stewart	

Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				
	1	A			SCHIST. Amphibole (hornblende?) with lesser amounts of plagioclase, orthoclase and quartz. Towards base of hole, increasing amounts of quartz, plagioclase and orthoclase. Strong fabric throughout.
2	B				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +59-05/317


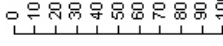
Core photograph



Sample +59-06/395

Original Site Number: JDR8

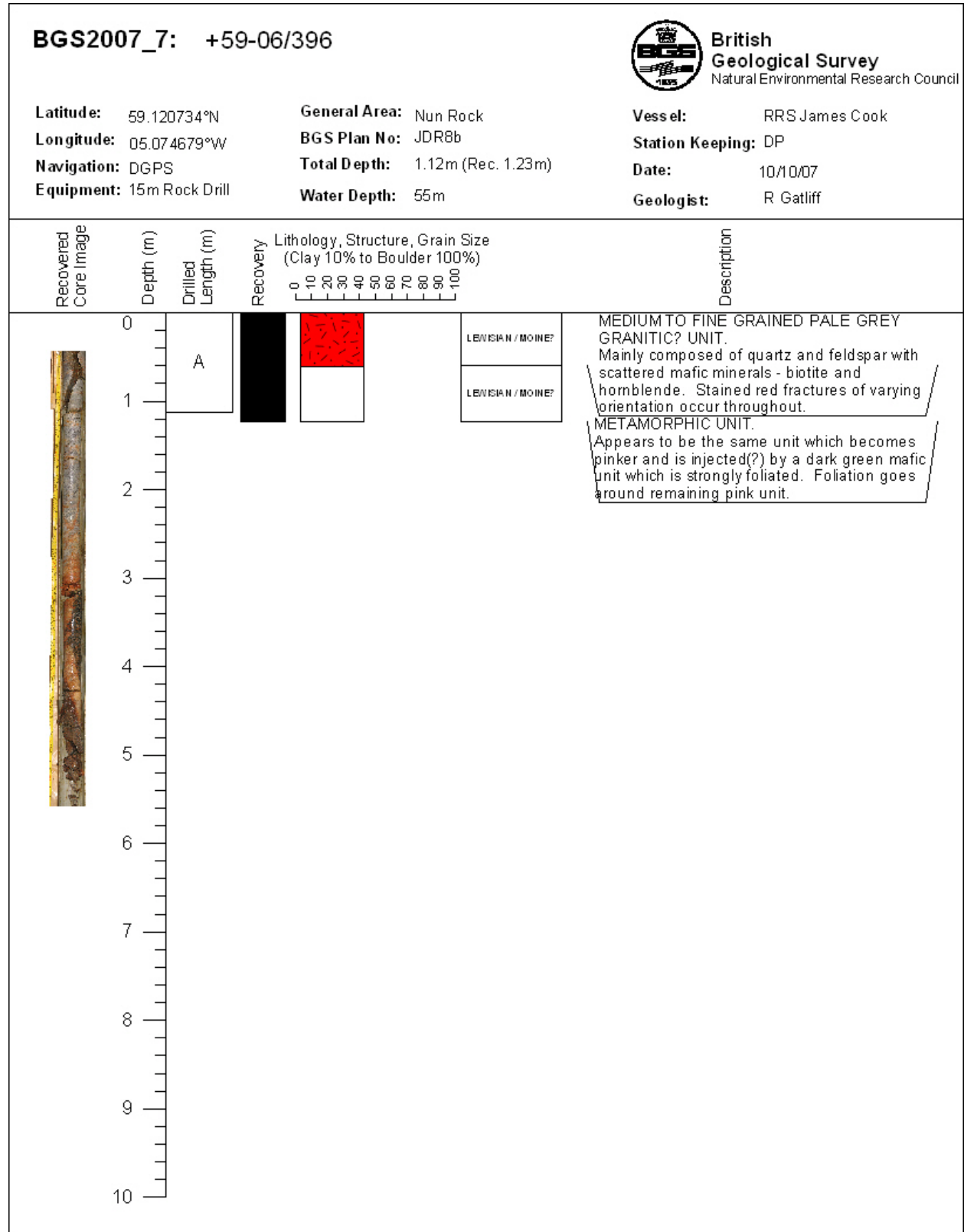
Location Nun Rock

BGS2007_7: +59-06/395		 British Geological Survey Natural Environmental Research Council			
Latitude: 59.1206°N	General Area: Nun Rock	Vessel: RRS James Cook			
Longitude: 05.07445°W	BGS Plan No: JDR8	Station Keeping: DP			
Navigation: DGPS	Total Depth: 0m	Date: 10/10/07			
Equipment: 15m Rock Drill	Water Depth: 53m	Geologist: R. Gatliff			
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description
	0				NO RECOVERY
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

Sample +59-06/396

Original Site Number: JDR8

Location Nun Rock



Sample +59-06/396




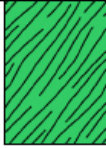
Core photograph



Sample +59-06/397

Original Site Number: JDR9

Location Nun Rock

BGS2007_7: +59-06/397		 British Geological Survey Natural Environmental Research Council				
Latitude: 59.123644°N	General Area: Nun Rock	Vessel: RRS James Cook				
Longitude: 05.110327°W	BGS Plan No: JDR9	Station Keeping: DP				
Navigation: DGPS	Total Depth: 1.24m (Rec. 1.12m)	Date: 10/10/07				
Equipment: 15m Rock Drill	Water Depth: 53m	Geologist: R Gatliff				
Recovered Core Image	Depth (m)	Drilled Length (m)	Recovery	Lithology, Structure, Grain Size (Clay 10% to Boulder 100%)	Description	
	0				AMPHIBOLE-MICA SCHIST. Dark grey / green unit with a strong schistose fabric throughout at approx 30 degrees to core. Fractures occur along mica rich bands. 2 quartz veins occur at 0.7m and 0.88m down the core.	
	1	A				LEWISIAN / MOINE?
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
10						

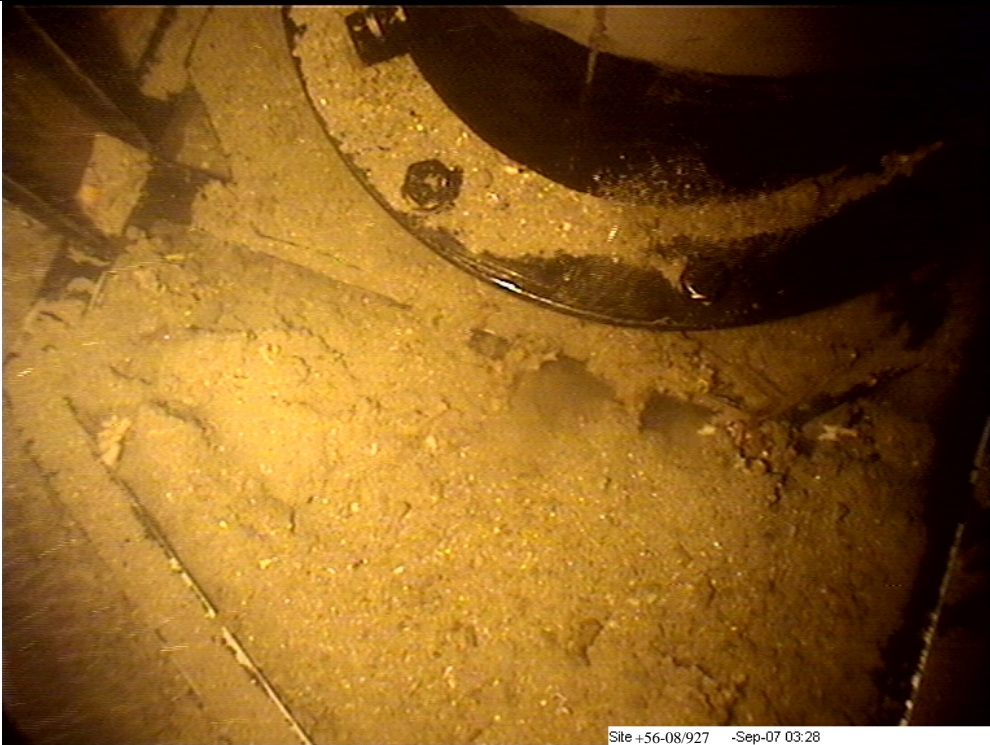

Sample +59-06/397

Core photograph

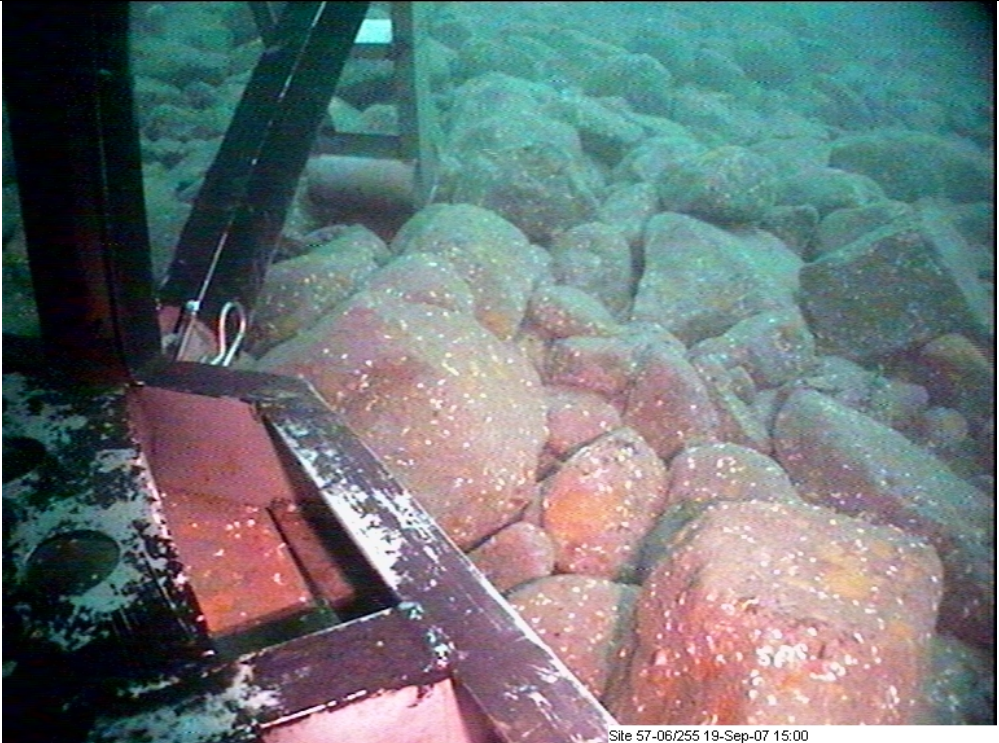




Appendix 1 Sea-bed Photographs for 15m Rock-drill Sites


Please note that the video data for each site is stored in the project folder on the BGS network.

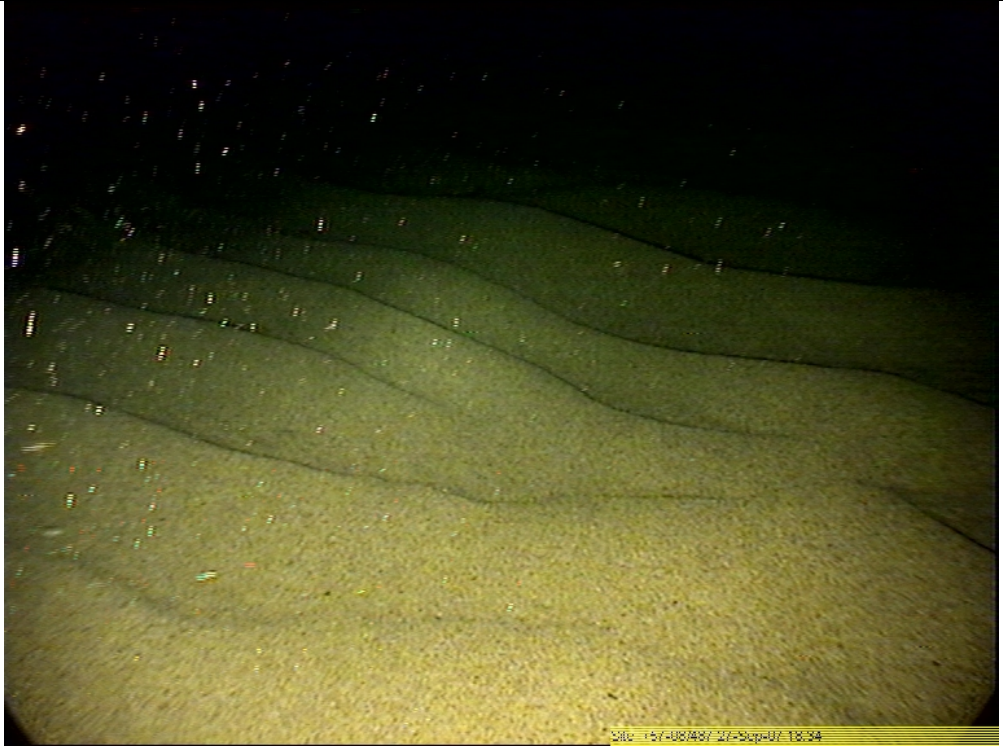

Sample Number	Sea-bed Photograph
<p>+56-08/927 DL1</p>	 <p>Site +56-08/927 -Sep-07 03:28</p>
<p>+56-08/928 DL10</p>	 <p>Site +56-08/928 26-Sep-07 04:15</p>



Sample Number	Sea-bed Photograph
<p>+56-08/929 DL11</p>	
<p>+57-06/254 SI50</p>	

Sample Number	Sea-bed Photograph
<p>+57-06/255</p> <p>SI51</p>	 <p>Site 57-06/255 19-Sep-07 15:00</p>
<p>+57-06/256</p> <p>SI49</p>	 <p>Site 57-06/256 19-Sep-07 22:47</p>

Sample Number	Sea-bed Photograph
<p>+57-06/262 SI46</p>	 <p>Site + 57-06/262 21-Sep-07 03:35</p>
<p>+57-06/263 SI47</p>	 <p>Site + 57-06/263 21-Sep-07 20:48</p>

Sample Number	Sea-bed Photograph
<p>+57-06/271 SI48</p>	


Sample Number	Sea-bed Photograph
<p>+57-08/487 JDR13</p>	
<p>+58-03/565 DL6</p>	



Sample Number	Sea-bed Photograph
<p>+58-03/566 DL7</p>	
<p>+58-05/389 JDR3</p>	


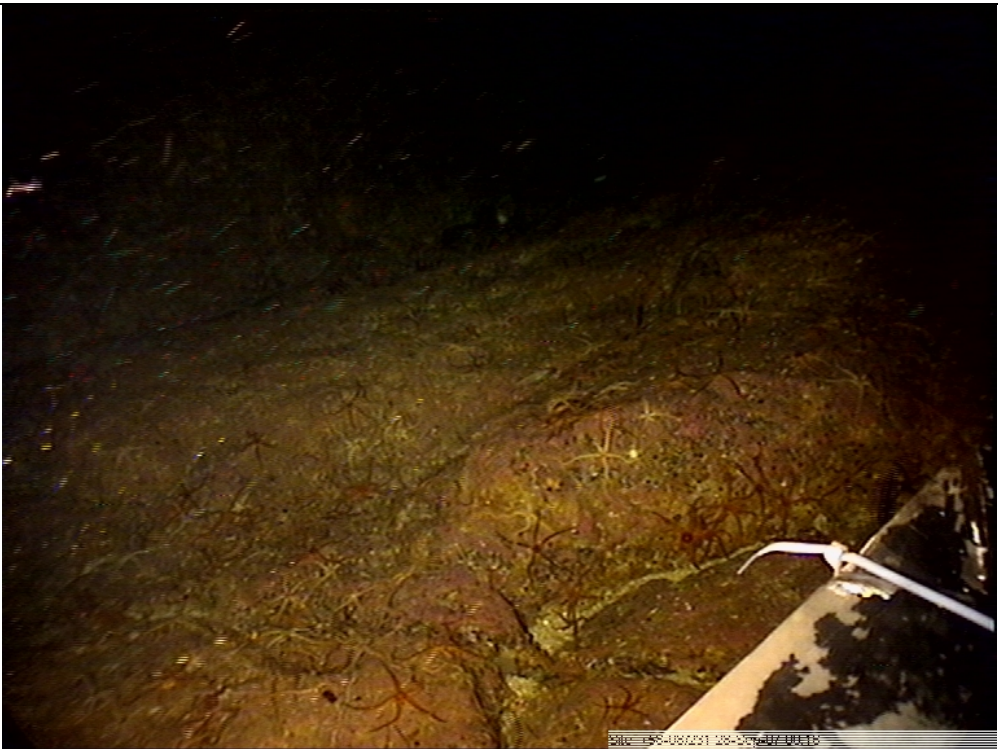
Sample Number	Sea-bed Photograph
<p>+58-05/390 JDR5</p>	 <p>Site +58-05/390 08-Oct-07 11:49</p> <p>Site +58-05/390 08-Oct-07 11:58</p>

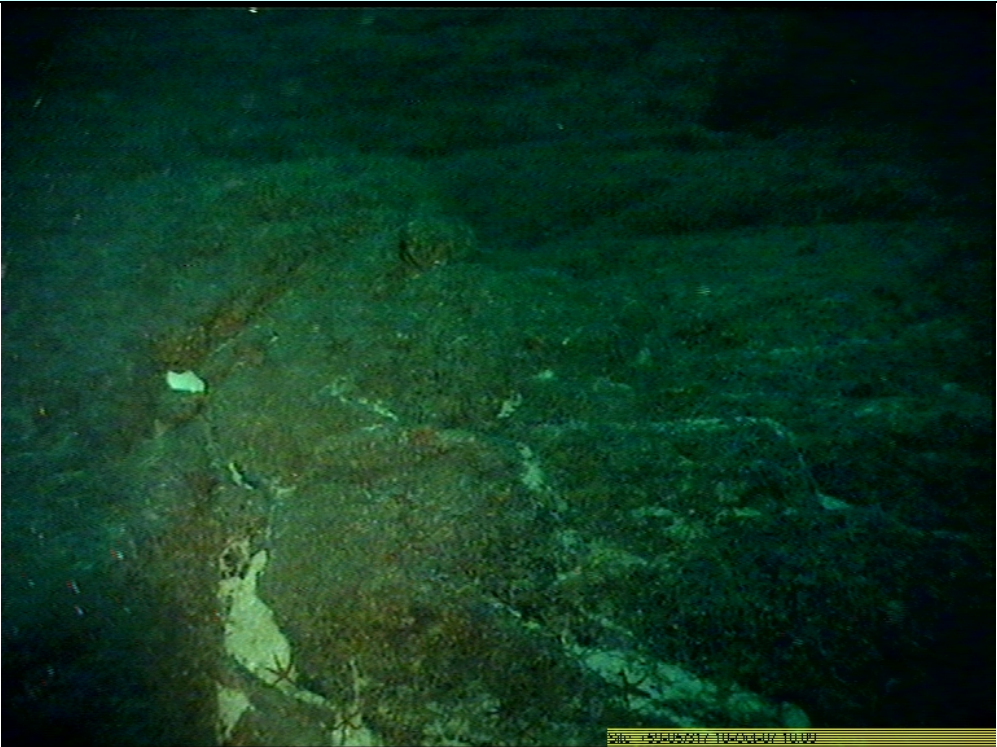
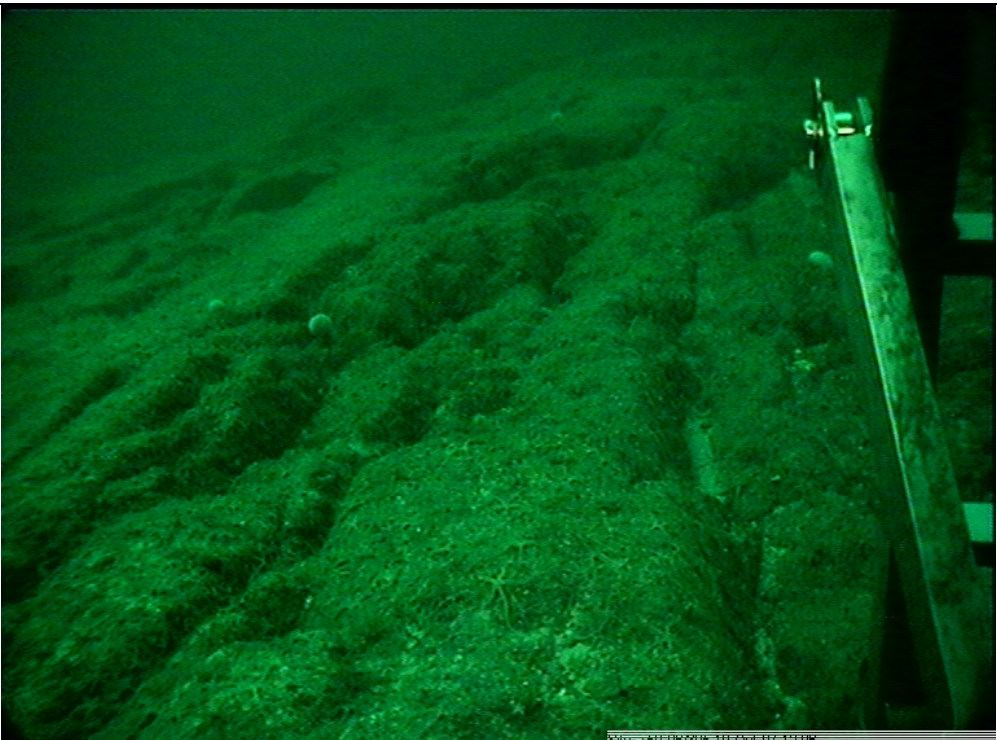
Sample Number	Sea-bed Photograph
<p>+58-05/391</p> <p>JDR6</p>	 <p>Site +58-05/391 08-Oct-07 16:41</p>
<p>+58-05/392</p> <p>JDR14</p>	 <p>Site +58-05/392 08-Oct-07 19:28</p>


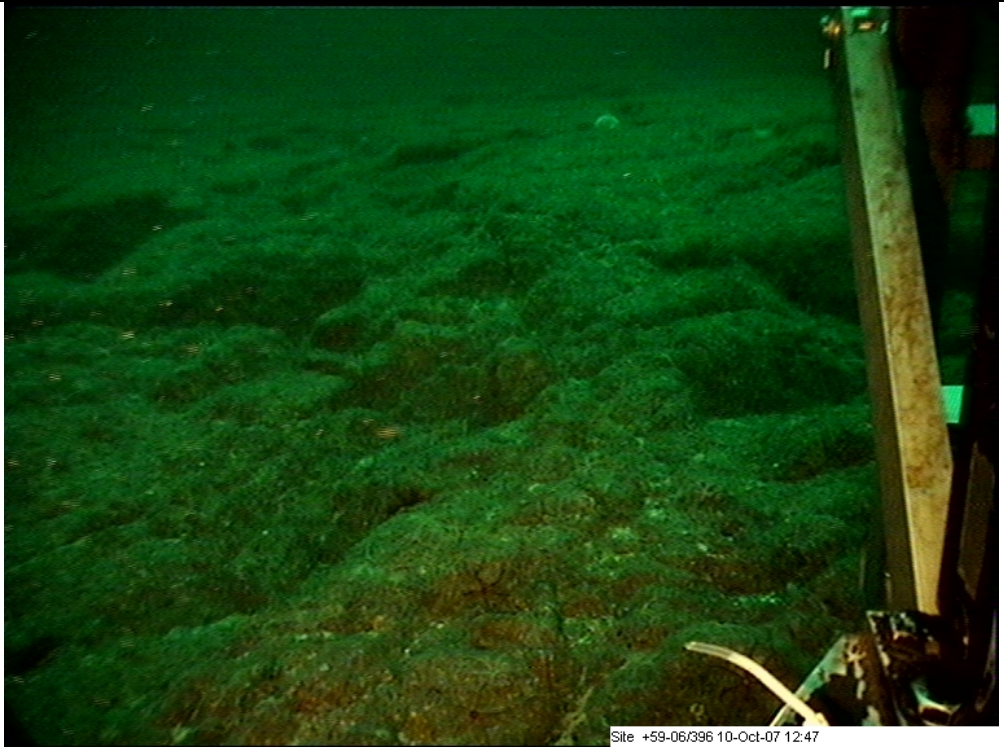
Sample Number	Sea-bed Photograph
<p>+58-05/393 JDR14</p>	 <p>Site +58-05/393 08-Oct-07 21:22</p>
<p>+58-05/394 JDR15</p>	

Sample Number	Sea-bed Photograph
<p>+58-05/395 JDR17</p>	 <p>The top photograph shows a dark, possibly muddy or silty seabed. Scattered across the surface are numerous small, irregular nodules in shades of orange and yellow. The lighting is somewhat dim, and the background is dark. The bottom photograph shows a close-up view of a metal frame or tray. Inside the frame, there is a dense layer of yellowish-orange material, which appears to be a sample collection or a filter residue. The metal frame is dark and has some visible bolts or fasteners. The overall scene is illuminated by a focused light source, likely from a submersible or ROV.</p>

Sample Number	Sea-bed Photograph
<p>+58-05/396 JDR16</p>	 <p>This photograph shows a close-up view of the sea bed. The seabed is covered with a dense layer of small, orange and white organisms, possibly sponges or corals. A metal structure, likely part of a sampling frame, is visible in the foreground on the left. The water is clear and blue.</p> <p>Site +58-05/396 09-Oct-07 16:07</p>
<p>+58-05/397 JDR4</p>	 <p>This photograph shows a wider view of the sea bed. The seabed is covered with a dense layer of green and white organisms, possibly sponges or corals. A metal structure, likely part of a sampling frame, is visible in the foreground on the left. The water is clear and blue.</p> <p>Site +58-05/397 09-Oct-07 16:12</p>

Sample Number	Sea-bed Photograph
<p>+58-05/398</p> <p>JDR18</p>	 <p>+58-05/398 08-20-07-00:18</p>
<p>+58-08/231</p> <p>JDR11</p>	 <p>+58-08/231 08-20-07-00:18</p>

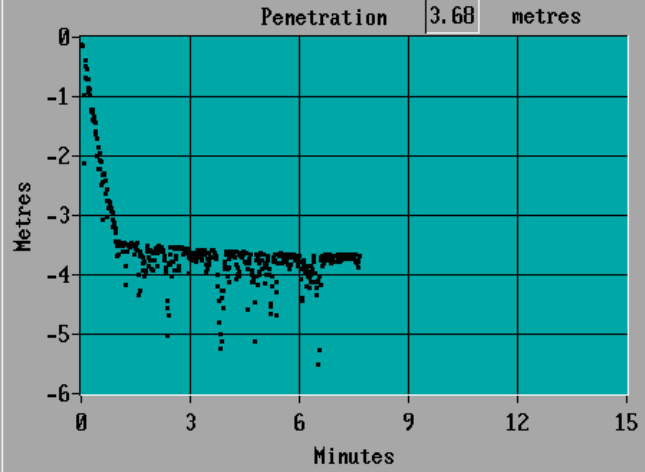
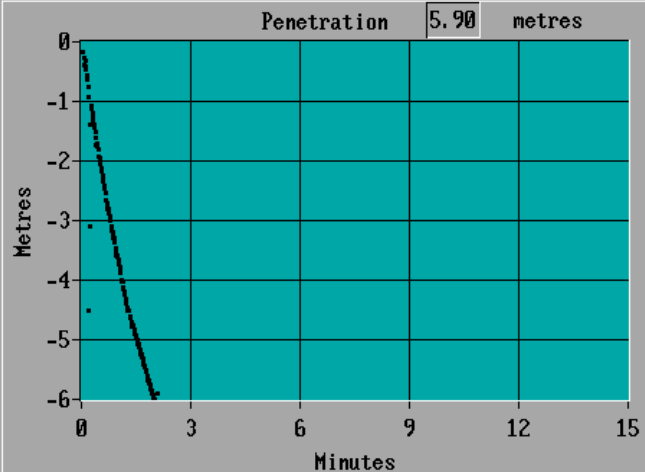
Sample Number	Sea-bed Photograph
<p>+59-05/317 JDR7</p>	 <p>This photograph shows a dark, rocky sea bed covered in a dense layer of green algae. The rocks are irregularly shaped and partially obscured by the algal growth. The lighting is somewhat dim, typical of an underwater environment. A small yellow scale bar is visible in the bottom right corner of the image.</p>
<p>+59-06/395 JDR8</p>	 <p>This photograph shows a sea bed covered in a thick, green, textured material, likely a type of algae or coral. The surface appears uneven and porous. On the right side of the frame, a vertical metal rod or part of a sampling equipment is visible. The overall lighting is greenish, possibly due to the water's color or the lighting used for the photograph. A small yellow scale bar is visible in the bottom right corner of the image.</p>

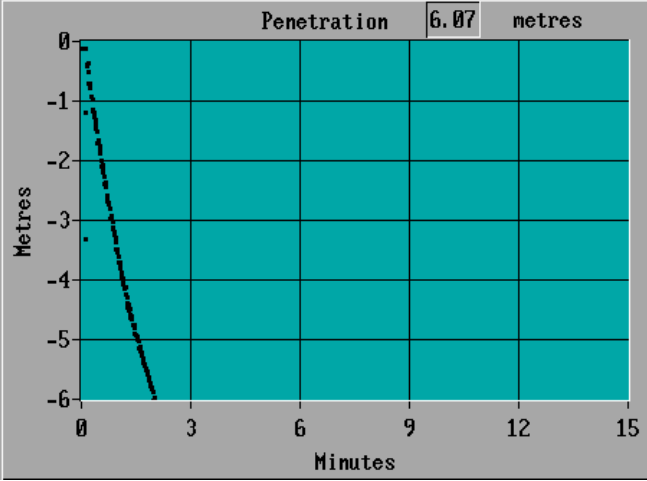
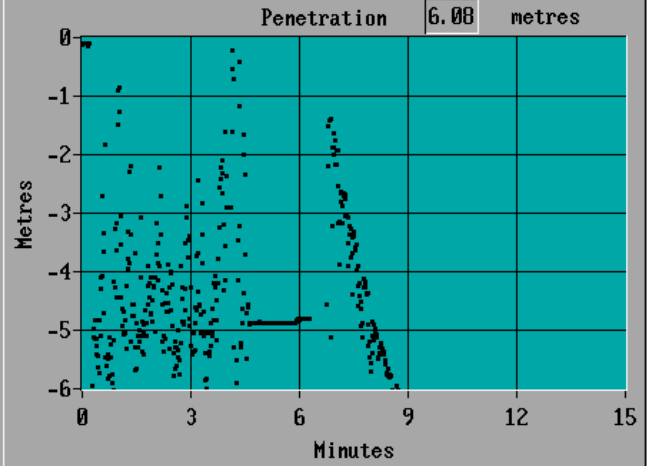
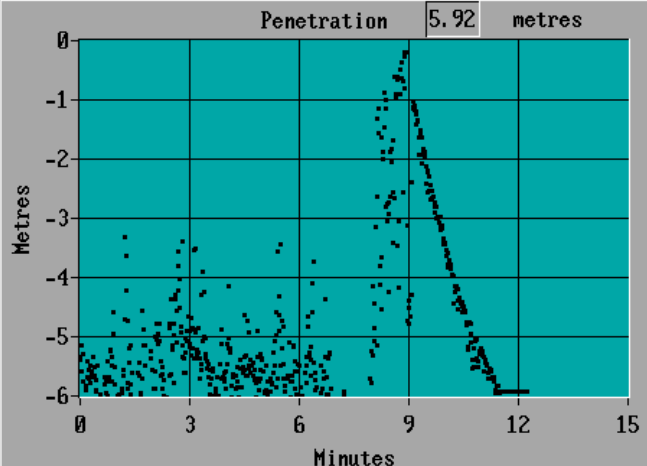
Sample Number	Sea-bed Photograph
	 <p>This photograph shows a close-up view of a dark metal structure, likely part of a submersible or sampling equipment, resting on a sea bed. The structure consists of several beams and a circular component. The sea bed is covered in a layer of sediment and some small, reddish-brown organisms. A timestamp in the bottom right corner reads "Site +59-06/396 10-Oct-07 12:07".</p>
<p>+59-06/396 JDR8</p>	 <p>This photograph shows a wide view of a sea bed covered in a dense, green, textured material, possibly a type of algae or microbial mat. The texture is uneven and appears to be composed of many small, rounded mounds. A vertical metal pole or structure is visible on the right side of the frame. A timestamp in the bottom right corner reads "Site +59-06/396 10-Oct-07 12:47".</p>

Sample Number	Sea-bed Photograph
<p>+59-06/397 JDR9</p>	 <p>Site +59-06/397 10-Oct-07 15:31</p>

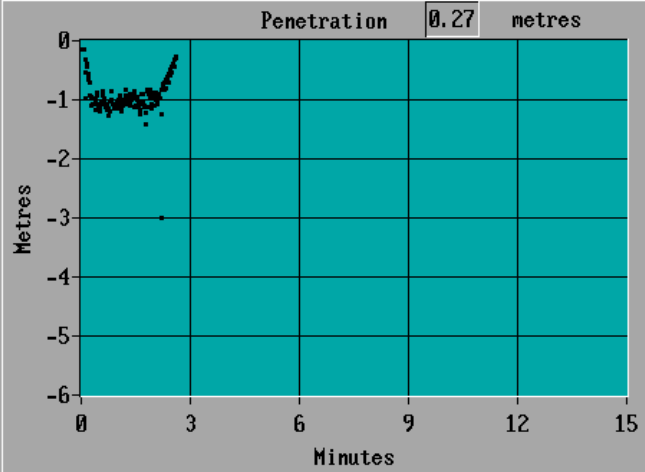
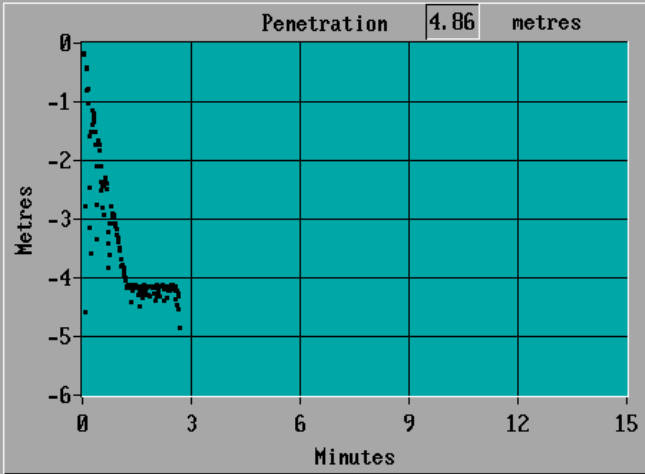
Appendix 2 6m Vibrocorer Penetration Rate Graphs

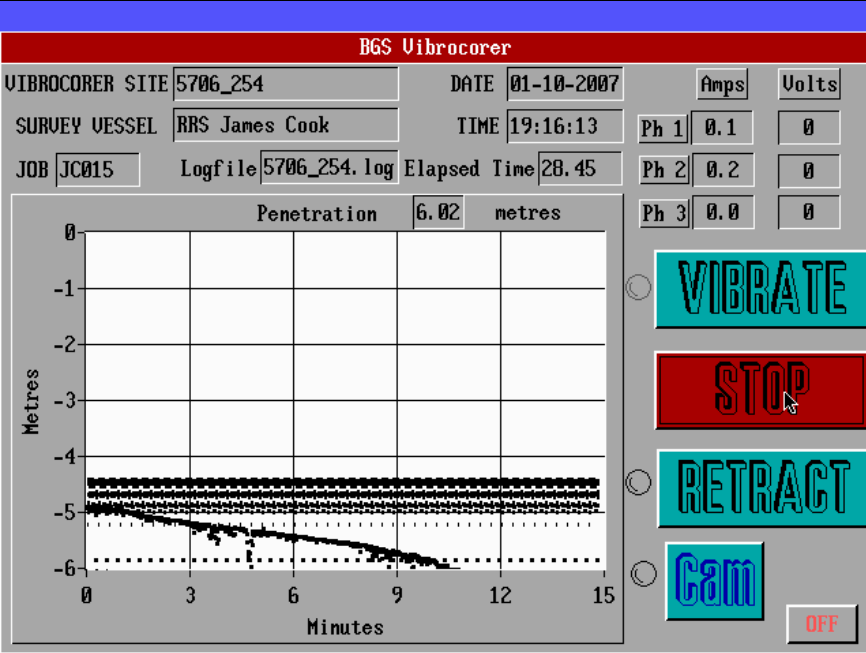
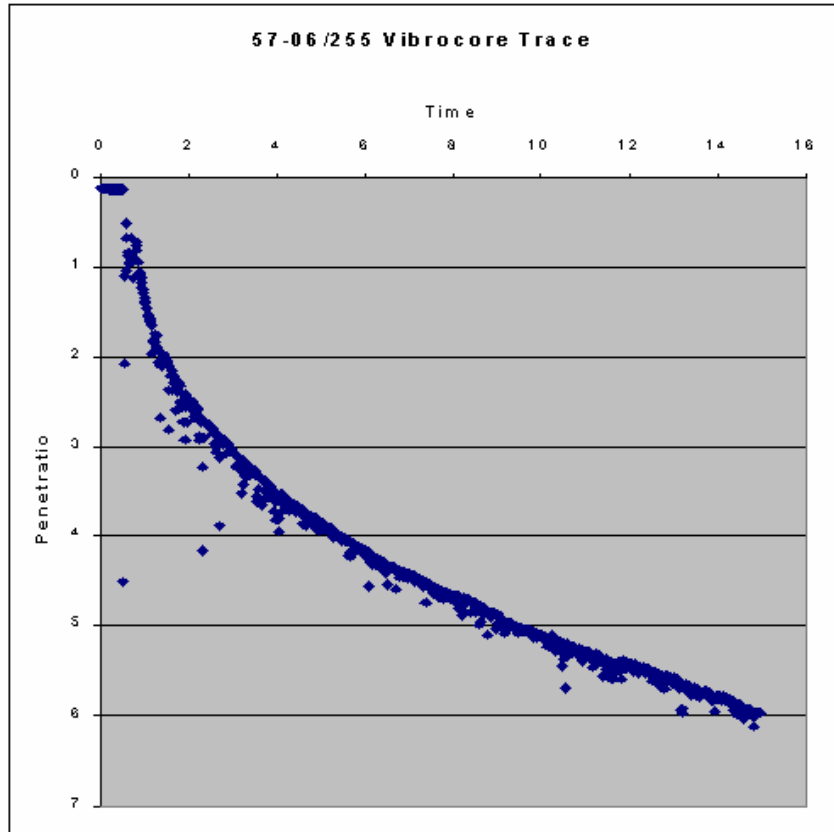
Please note that the video data for each site is stored in the project folder on the BGS network. No sea-bed photographs have been produced for the vibrocorer sites.

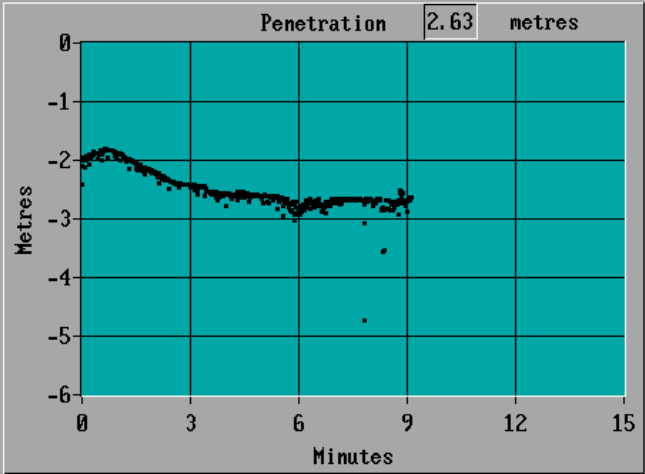
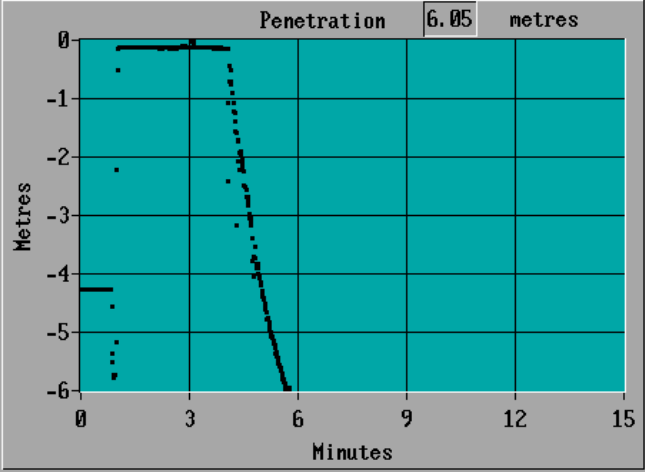
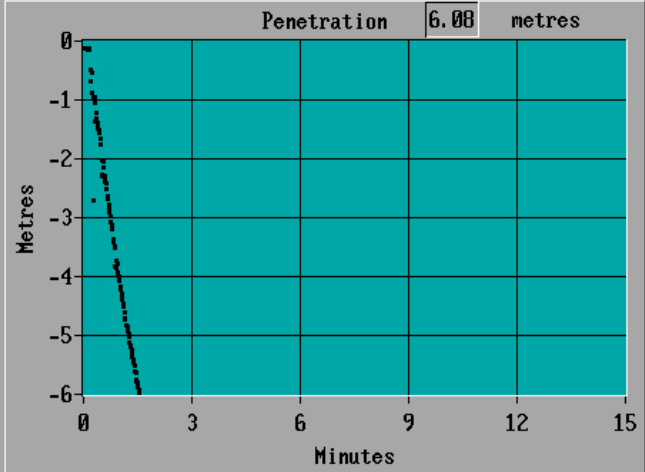
Sample Number	Penetration Rate Graph																
<p>+56-06/170VE LL4</p>	<div style="border: 1px solid black; padding: 5px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">VIBROCORER SITE</td> <td style="width: 25%;">5606_170</td> <td style="width: 25%;">DATE</td> <td>05-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>12:19:05</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5606_170.log</td> </tr> <tr> <td></td> <td></td> <td>Elapsed Time</td> <td>7.40</td> </tr> </table> <div style="text-align: right; margin-top: 5px;"> Penetration 3.68 metres </div>  </div>	VIBROCORER SITE	5606_170	DATE	05-10-2007	SURVEY VESSEL	RRS James Cook	TIME	12:19:05	JOB	JC015	Logfile	5606_170.log			Elapsed Time	7.40
VIBROCORER SITE	5606_170	DATE	05-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	12:19:05														
JOB	JC015	Logfile	5606_170.log														
		Elapsed Time	7.40														
<p>+56-06/171VE LL3</p>	<p>No recovery</p>																
<p>+56-06/172VE LL2</p>	<p>No recovery</p>																
<p>+56-06/173VE LL1</p>	<div style="border: 1px solid black; padding: 5px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">VIBROCORER SITE</td> <td style="width: 25%;">5606_173</td> <td style="width: 25%;">DATE</td> <td>05-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>14:06:05</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5606_173.log</td> </tr> <tr> <td></td> <td></td> <td>Elapsed Time</td> <td>2.05</td> </tr> </table> <div style="text-align: right; margin-top: 5px;"> Penetration 5.90 metres </div>  </div>	VIBROCORER SITE	5606_173	DATE	05-10-2007	SURVEY VESSEL	RRS James Cook	TIME	14:06:05	JOB	JC015	Logfile	5606_173.log			Elapsed Time	2.05
VIBROCORER SITE	5606_173	DATE	05-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	14:06:05														
JOB	JC015	Logfile	5606_173.log														
		Elapsed Time	2.05														

Sample Number	Penetration Rate Graph
<p>+56-06/174VE LL5</p>	<p>VIBROCORER SITE <input type="text" value="5606_174"/> DATE <input type="text" value="05-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="14:47:26"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5606_174.log"/> Elapsed Time <input type="text" value="2.16"/></p> <p>Penetration <input type="text" value="6.07"/> metres</p> 
<p>+56-07/726VE JH2</p>	<p>VIBROCORER SITE <input type="text" value="5607_726VE"/> DATE <input type="text" value="05-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="23:52:13"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5607_726.log"/> Elapsed Time <input type="text" value="8.47"/></p> <p>Penetration <input type="text" value="6.08"/> metres</p> 
<p>+56-07/727VE JH6</p>	<p>VIBROCORER SITE <input type="text" value="5607_727VE"/> DATE <input type="text" value="06-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="03:11:02"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5607_727.log"/> Elapsed Time <input type="text" value="18.13"/></p> <p>Penetration <input type="text" value="5.92"/> metres</p> 

Sample Number	Penetration Rate Graph																
<p>+56-07/728VE JH5</p>	<table border="1"> <tr> <td>VIBROCORER SITE</td> <td>5607_728VE</td> <td>DATE</td> <td>06-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>05:37:48</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5607_728.log</td> </tr> <tr> <td colspan="2"></td> <td>Elapsed Time</td> <td>12.43</td> </tr> </table>	VIBROCORER SITE	5607_728VE	DATE	06-10-2007	SURVEY VESSEL	RRS James Cook	TIME	05:37:48	JOB	JC015	Logfile	5607_728.log			Elapsed Time	12.43
VIBROCORER SITE	5607_728VE	DATE	06-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	05:37:48														
JOB	JC015	Logfile	5607_728.log														
		Elapsed Time	12.43														
<p>+56-08/929VE DL11</p>	<table border="1"> <tr> <td>VIBROCORER SITE</td> <td>5608_929VE</td> <td>DATE</td> <td>04-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>05:22:55</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5608_929.log</td> </tr> <tr> <td colspan="2"></td> <td>Elapsed Time</td> <td>8.37</td> </tr> </table>	VIBROCORER SITE	5608_929VE	DATE	04-10-2007	SURVEY VESSEL	RRS James Cook	TIME	05:22:55	JOB	JC015	Logfile	5608_929.log			Elapsed Time	8.37
VIBROCORER SITE	5608_929VE	DATE	04-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	05:22:55														
JOB	JC015	Logfile	5608_929.log														
		Elapsed Time	8.37														
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VIBROCORER SITE	5608_930VE	DATE	04-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	10:21:16														
JOB	JC015	Logfile	5608_930.log														
		Elapsed Time	17.43														

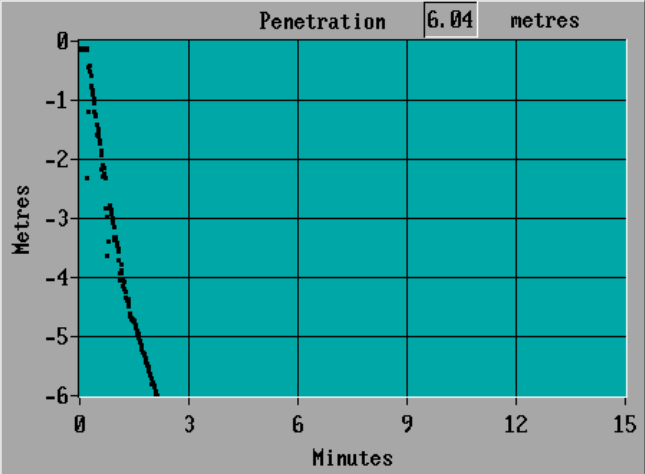
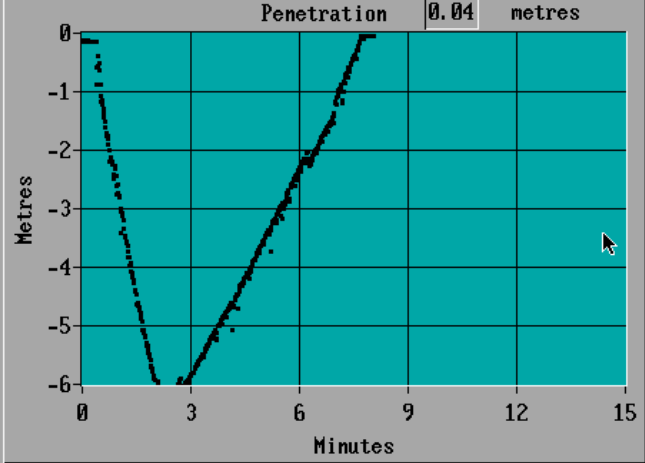
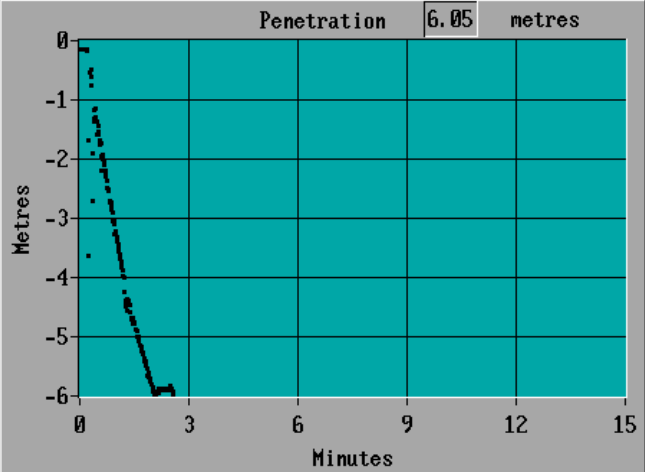
Sample Number	Penetration Rate Graph																
+56-08/931VE DL14	No recovery																
+56-08/932VE DL15	No recovery																
+56-08/933VE DL16	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">VIBROCORER SITE</td> <td style="width: 30%;">5608_933</td> <td style="width: 20%;">DATE</td> <td style="width: 20%;">04-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>13:06:18</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5608_933.log</td> </tr> <tr> <td></td> <td></td> <td>Elapsed Time</td> <td>2.37</td> </tr> </table> <div style="text-align: right; margin-top: 5px;"> Penetration 0.27 metres </div> 	VIBROCORER SITE	5608_933	DATE	04-10-2007	SURVEY VESSEL	RRS James Cook	TIME	13:06:18	JOB	JC015	Logfile	5608_933.log			Elapsed Time	2.37
VIBROCORER SITE	5608_933	DATE	04-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	13:06:18														
JOB	JC015	Logfile	5608_933.log														
		Elapsed Time	2.37														
+56-08/934VE DL12	No recovery																
+56-08/935VE DL17	No recovery																
+56-08/936VE DL18	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">VIBROCORER SITE</td> <td style="width: 30%;">5608_936</td> <td style="width: 20%;">DATE</td> <td style="width: 20%;">04-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>13:57:16</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5608_936.log</td> </tr> <tr> <td></td> <td></td> <td>Elapsed Time</td> <td>2.41</td> </tr> </table> <div style="text-align: right; margin-top: 5px;"> Penetration 4.86 metres </div> 	VIBROCORER SITE	5608_936	DATE	04-10-2007	SURVEY VESSEL	RRS James Cook	TIME	13:57:16	JOB	JC015	Logfile	5608_936.log			Elapsed Time	2.41
VIBROCORER SITE	5608_936	DATE	04-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	13:57:16														
JOB	JC015	Logfile	5608_936.log														
		Elapsed Time	2.41														

Sample Number	Penetration Rate Graph
<p>+57-06/254VE SI50</p>	 <p>BGS Vibrocorer</p> <p>VIBROCORDER SITE: 5706_254 DATE: 01-10-2007 Amps: Volts: 0</p> <p>SURVEY VESSEL: RRS James Cook TIME: 19:16:13 Ph 1: 0.1 0</p> <p>JOB: JC015 Logfile: 5706_254.log Elapsed Time: 28.45 Ph 2: 0.2 0</p> <p>Penetration: 6.02 metres Ph 3: 0.0 0</p> <p>Buttons: VIBRATE, STOP, RETRACT, Cam, OFF</p>
<p>+57-06/255VE SI51</p>	 <p>57-06/255 Vibrocore Trace</p> <p>Time: 0, 2, 4, 6, 8, 10, 12, 14, 16</p> <p>Penetration: 0, 1, 2, 3, 4, 5, 6, 7</p>

Sample Number	Penetration Rate Graph
<p>+57-06/256VE SI49</p>	<p>VIBROCORER SITE <input type="text" value="5706_256VE"/> DATE <input type="text" value="01-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="09:03:51"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5706_256.log"/> Elapsed Time <input type="text" value="15.06"/></p> <p>Penetration <input type="text" value="2.63"/> metres</p> 
<p>+57-06/258VE SI40</p>	<p>VIBROCORER SITE <input type="text" value="5706_258VE"/> DATE <input type="text" value="30-09-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="10:29:57"/> JOB <input type="text" value="JC0015"/> Logfile <input type="text" value="5706_258.log"/> Elapsed Time <input type="text" value="5.53"/></p> <p>Penetration <input type="text" value="6.05"/> metres</p> 
<p>+57-06/259VE SI61</p>	<p>VIBROCORER SITE <input type="text" value="5706_259"/> DATE <input type="text" value="30-09-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="15:36:39"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5706_259.log"/> Elapsed Time <input type="text" value="1.36"/></p> <p>Penetration <input type="text" value="6.00"/> metres</p> 

Sample Number	Penetration Rate Graph																
<p>+57-06/260VE SI62</p>	<table border="1"> <tr> <td>VIBROCORER SITE</td> <td>5706_260</td> <td>DATE</td> <td>30-09-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>13:07:57</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5706_260.log</td> </tr> <tr> <td colspan="2"></td> <td>Elapsed Time</td> <td>1.59</td> </tr> </table> <p>Penetration 6.07 metres</p>	VIBROCORER SITE	5706_260	DATE	30-09-2007	SURVEY VESSEL	RRS James Cook	TIME	13:07:57	JOB	JC015	Logfile	5706_260.log			Elapsed Time	1.59
VIBROCORER SITE	5706_260	DATE	30-09-2007														
SURVEY VESSEL	RRS James Cook	TIME	13:07:57														
JOB	JC015	Logfile	5706_260.log														
		Elapsed Time	1.59														
<p>+57-06/261VE SI63</p>	<table border="1"> <tr> <td>VIBROCORER SITE</td> <td>5706_261</td> <td>DATE</td> <td>30-09-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>11:23:51</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5706_261.log</td> </tr> <tr> <td colspan="2"></td> <td>Elapsed Time</td> <td>1.54</td> </tr> </table> <p>Penetration 6.07 metres</p>	VIBROCORER SITE	5706_261	DATE	30-09-2007	SURVEY VESSEL	RRS James Cook	TIME	11:23:51	JOB	JC015	Logfile	5706_261.log			Elapsed Time	1.54
VIBROCORER SITE	5706_261	DATE	30-09-2007														
SURVEY VESSEL	RRS James Cook	TIME	11:23:51														
JOB	JC015	Logfile	5706_261.log														
		Elapsed Time	1.54														
<p>+57-06/262VE SI46</p>	<table border="1"> <tr> <td>VIBROCORER SITE</td> <td>5706_262</td> <td>DATE</td> <td>29-09-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>14:22:33</td> </tr> <tr> <td>JOB</td> <td>JC0015</td> <td>Logfile</td> <td>5706_262.log</td> </tr> <tr> <td colspan="2"></td> <td>Elapsed Time</td> <td>2.11</td> </tr> </table> <p>Penetration 5.87 metres</p>	VIBROCORER SITE	5706_262	DATE	29-09-2007	SURVEY VESSEL	RRS James Cook	TIME	14:22:33	JOB	JC0015	Logfile	5706_262.log			Elapsed Time	2.11
VIBROCORER SITE	5706_262	DATE	29-09-2007														
SURVEY VESSEL	RRS James Cook	TIME	14:22:33														
JOB	JC0015	Logfile	5706_262.log														
		Elapsed Time	2.11														

Sample Number	Penetration Rate Graph																
<p>+57-06/263VE SI47</p>	<p style="text-align: center;">57-06/263VE Penetration Curve</p>																
<p>+57-06/264VE SI53</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">UIBROCORER SITE</td> <td style="width: 25%;">5706_264</td> <td style="width: 25%;">DATE</td> <td>02-10-2007</td> </tr> <tr> <td>SURVEY VESSEL</td> <td>RRS James Cook</td> <td>TIME</td> <td>12:29:51</td> </tr> <tr> <td>JOB</td> <td>JC015</td> <td>Logfile</td> <td>5706_264.log</td> </tr> <tr> <td></td> <td></td> <td>Elapsed Time</td> <td>5.51</td> </tr> </table> <p style="text-align: center;">Penetration 5.37 metres</p>	UIBROCORER SITE	5706_264	DATE	02-10-2007	SURVEY VESSEL	RRS James Cook	TIME	12:29:51	JOB	JC015	Logfile	5706_264.log			Elapsed Time	5.51
UIBROCORER SITE	5706_264	DATE	02-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	12:29:51														
JOB	JC015	Logfile	5706_264.log														
		Elapsed Time	5.51														
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UIBROCORER SITE	5706_267	DATE	02-10-2007														
SURVEY VESSEL	RRS James Cook	TIME	13:11:24														
JOB	JC015	Logfile	5706_267.log														
		Elapsed Time	6.21														

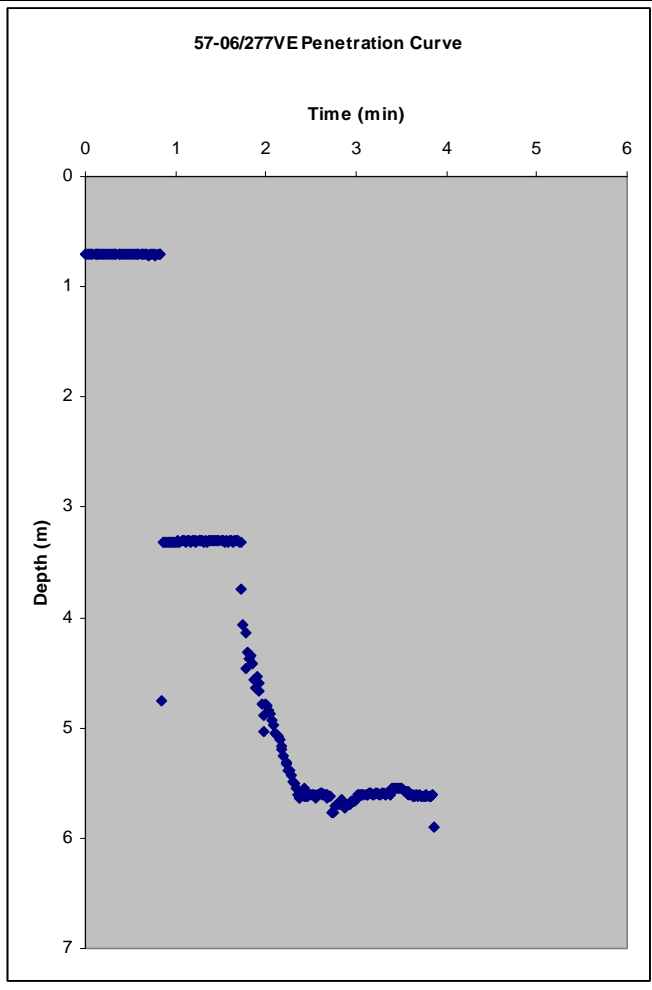
Sample Number	Penetration Rate Graph
<p>+57-06/268VE SI39</p>	<p>VIBROCORER SITE <input type="text" value="5706_268"/> DATE <input type="text" value="01-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="15:05:52"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5706_268.log"/> Elapsed Time <input type="text" value="2.25"/></p> <p>Penetration <input type="text" value="6.04"/> metres</p> 
<p>+57-06/269VE SI54</p>	<p>VIBROCORER SITE <input type="text" value="5706_269"/> DATE <input type="text" value="01-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="14:09:42"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5706_269.log"/> Elapsed Time <input type="text" value="8.04"/></p> <p>Penetration <input type="text" value="0.04"/> metres</p> 
<p>+57-06/270VE SI41</p>	<p>VIBROCORER SITE <input type="text" value="5706-270"/> DATE <input type="text" value="01-10-2007"/> SURVEY VESSEL <input type="text" value="RRS James Cook"/> TIME <input type="text" value="13:06:54"/> JOB <input type="text" value="JC015"/> Logfile <input type="text" value="5706-270.log"/> Elapsed Time <input type="text" value="2.46"/></p> <p>Penetration <input type="text" value="6.05"/> metres</p> 

Sample Number	Penetration Rate Graph																
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UIBROCORER SITE	5706_272	DATE	29-09-2007														
SURVEY VESSEL	RRS James Cook	TIME	16:34:03														
JOB	JC0015	Logfile	5706_272.log														
		Elapsed Time	1.39														

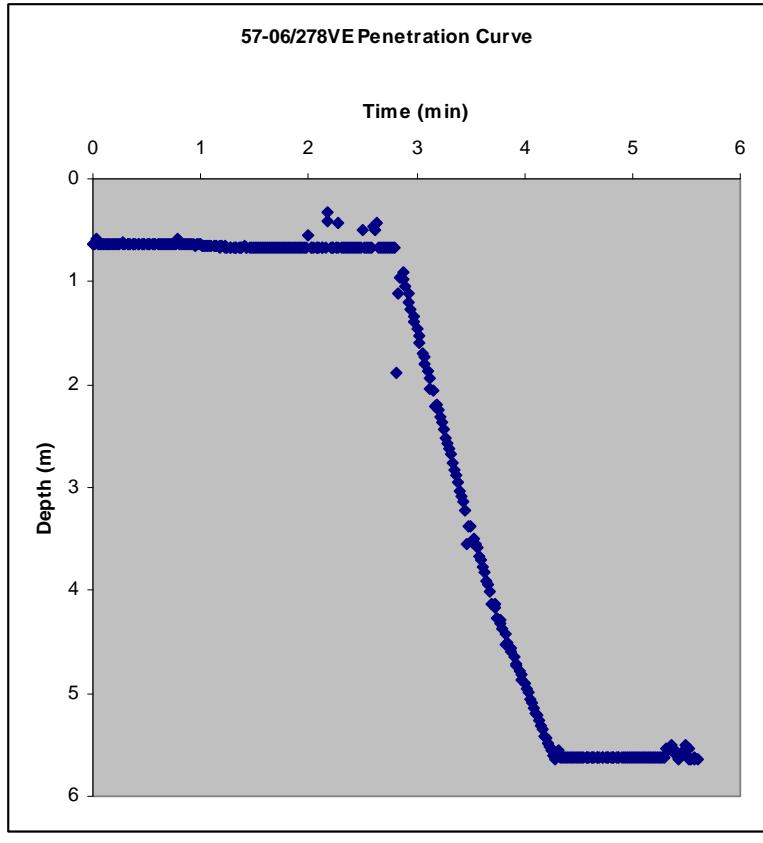
Sample Number	Penetration Rate Graph																				
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VIBROCRORER SITE <input type="text" value="5706_273"/>	DATE <input type="text" value="29-09-2007"/>																				
SURVEY VESSEL <input type="text" value="RRS James Cook"/>	TIME <input type="text" value="17:36:23"/>																				
JOB <input type="text" value="JC0015"/> Logfile <input type="text" value="5706_273.log"/>	Elapsed Time <input type="text" value="14.29"/>																				
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Sample Number **Penetration Rate Graph**

+57-06/277VE
SI57

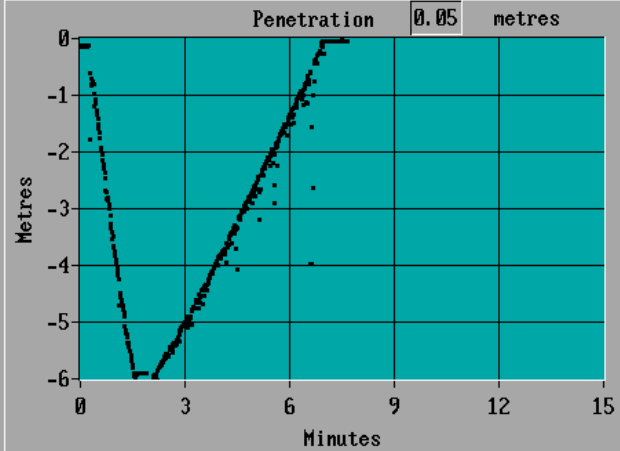
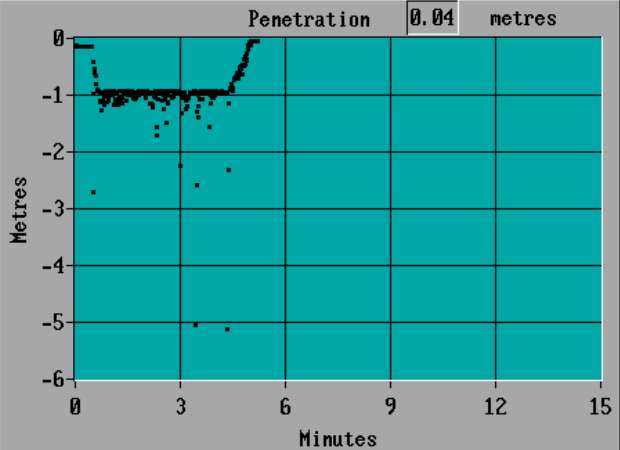
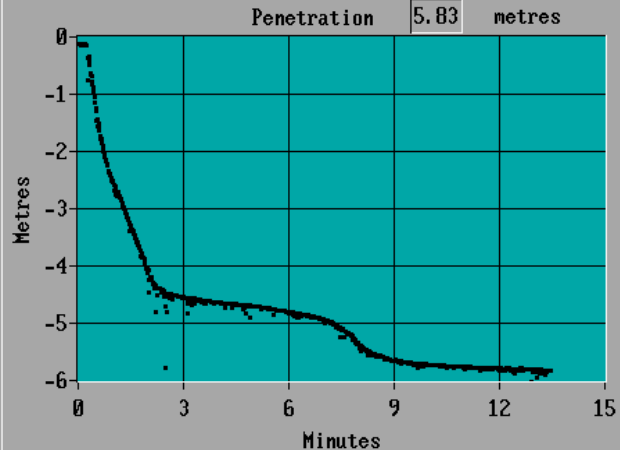


+57-06/278VE
SI58



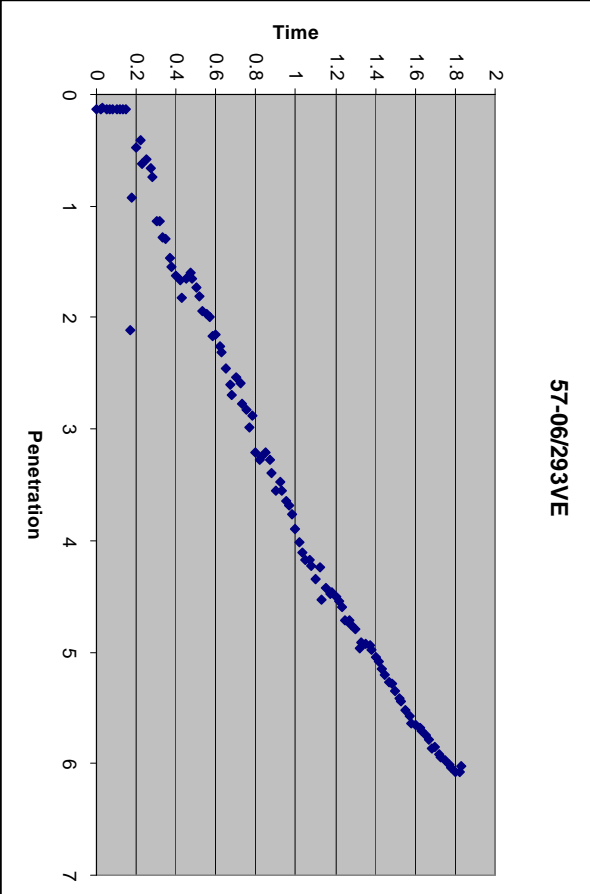
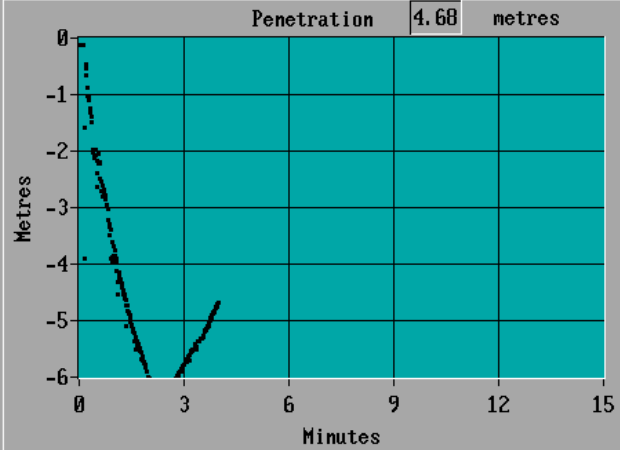
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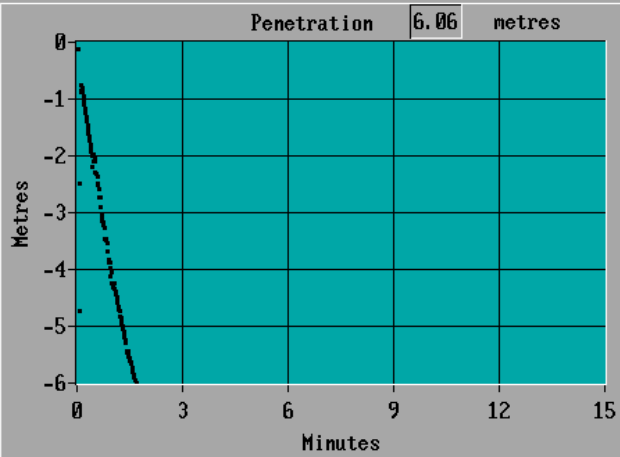
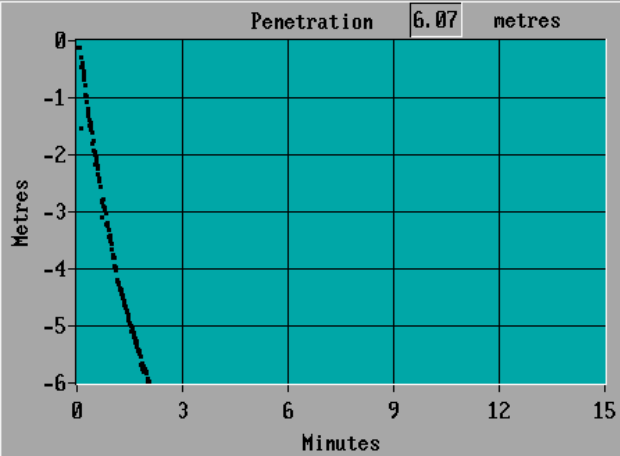
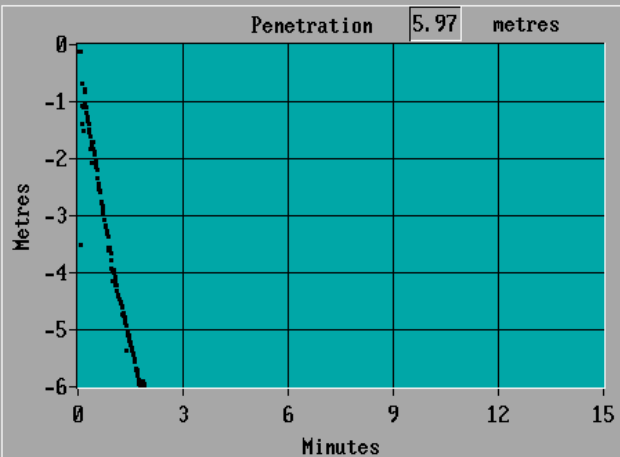
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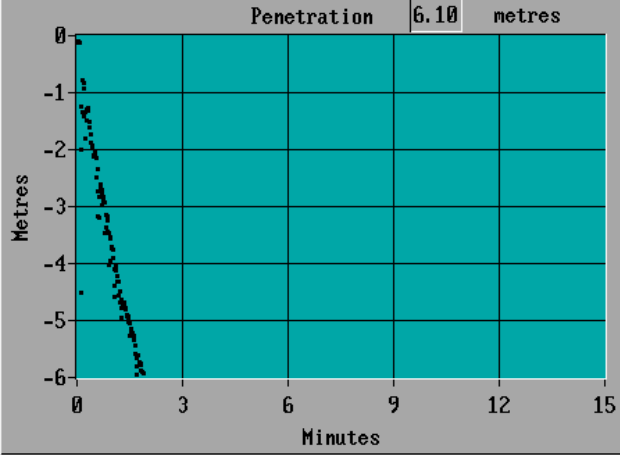
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		Elapsed Time	3.59														

Sample Number	Penetration Rate Graph
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JOB	JC015	Logfile	5706_298.log	Elapsed Time	2.15	
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Penetration		6.10	metres			

Appendix 3 Equipment

VESSEL

Name:	<i>RRS James Cook</i>
Length:	89.2m
Beam:	18:6m
Draught:	6.0m
Owner:	Natural Environment Research Council, UK.

Please see [Figure 11](#) for the *RRS James Cook* deck plan.

BGS 15 METRE ROCK-DRILL

The BGS 15m rock-drill ([Figure 12](#)) was utilised in the Moray Firth, Nun Rock, Summer Isles, Flannan and Mingulay areas. Deployment was over the stern of the vessel using the ship's A-frame and the BGS combined power hoist umbilical cable winch system. During deployment the vessel was held on station using dynamic positioning. The winch was controlled from the rock-drill shack located on the back deck of the vessel with visual and oral contact and radio communication maintained at all times between the bridge and main deck. The A-frame was controlled by the vessel deck crew with constant contact with the BGS winch operator.

All rock-drill functions were PC controlled utilising a BGS customised Jupiter program allowing the operator to observe progress and make adjustments to the coring parameters. As the 15m rock-drill is a multiple core-barrel and rod system, all core-barrel and rod additions and retractions were controlled by this control PC.

Penetration, feed pressure, revolutions per minute and torque are displayed on graphs for the drilling operator to monitor progress. There are a variety of other sensors fitted including pitch and roll to check for stability of the frame on the sea bed and a network of real-time feed cameras that are used to check ground conditions prior to landing the drill frame on the sea bed and to monitor drilling operations. Digital records of the photographs taken and video from drilling operations are stored on the BGS network under this cruise number.

Once the used core-barrels are removed to the purpose built core bench the core bit and reamer are removed from the bottom end and the water swivel assembly from the top end of each of the outer core-barrels. Each inner core-barrel is then removed and laid on the bench in sequence to avoid confusion. Using a suitable pusher and valve system, water is then pumped into each inner core-barrel from the top and the core extruded at the bottom into sections of labelled plastic guttering. After cleaning, photographing and examination the core is stored in cardboard boxes with polystyrene spacers to identify any sections subsampled and to secure gaps in the packing prior to transportation.

BGS 6 METRE VIBROCORER

The BGS 6m vibrocorer ([Figure 13](#)) was utilised in the Mingulay, Summer Isles, Loch Hourn, Loch Nevis and island of Muck areas. Deployment, positioning, winch control and communication procedures were the same as those used during 15m rock-drill operations.

All vibrocorer functions were PC controlled and a monitor display allowed the operator to observe progress and make variations to the coring parameters. A digital log of vibrocorer

progress was recorded for each site and is stored digitally on the BGS network under this cruise number. A sea-bed looking camera was also fitted to the rig and a snapshot of the sea bed was taken before drilling; this is also stored digitally on the BGS network. The camera assisted in identifying any potential hazards and the suitability of each site ahead of coring.

The vibrocorer can collect up to 6m of soft sediment core of variable lithology in a steel core-barrel with plastic liner tube, stainless-steel core catcher and carbon-steel cutting shoe. A neoprene 'O' ring seals the annular space between liner and core-barrel. The polycarbonate liner is used for sample storage after cutting into suitable lengths and capping and taping each length. During the vibrocoring process a 6-tonne vibration force is delivered to the core-cutting shoe and upon full penetration or refusal to go further (as seen on the operator display) the vibration is switched off. The barrel is then retracted back into the frame before the corer leaves the sea bed.

The liner complete with core is extracted from the core-barrel and laid out along the core bench. The liner is then marked with an orientation line, sectioned into maximum 1m lengths and capped with a yellow cap on the top and a black cap on the base of each section. Each section is labelled with the site number and identifying alpha-numeric code before stored in cardboard boxes labelled with identical marking to that of the core inside.

BGS GRAVITY-CORER

The gravity-corer was used in the Summer Isles area and comprises a heavy (250-1000kg) lead weight shrouded in steel ([Figure 14](#)). Samples are obtained by gravity impact and collected in a steel core-barrel with plastic liner tube, stainless-steel core catcher and carbon-steel cutting shoe. A neoprene 'O' ring seals the space between liner and core-barrel.

The system for deployment and recovery was via the starboard ship's winch ([Figure 11](#)) and stored on the starboard side of the deck. During deployment and recovery the vessel was held by dynamic positioning. Once the gravity-corer is recovered to the deck the core-barrel is removed to the core bench where the liner with core is extruded.

Core extraction, sectioning and labelling procedures are the same as described above for 6m vibrocore samples.

GEOPHYSICAL SURVEY EQUIPMENT

RRS James Cook ship-board geophysical equipment were utilised on this cruise. The vessel is fitted with two multibeam echosounder systems (EM120 and EM710) and a sub-bottom profiler system (Simrad SBP120). These systems were utilised as reconnaissance tools to confirm ground conditions on site and also for areas of survey in the Summer Isles and Mingulay areas. Data quality is variable due to a combination of poor weather and sea-state conditions, as well as aeration beneath the hull of the ship.

EM 710 Multibeam Echosounder

The Simrad EM 710 system is designed for high-resolution sea-bed mapping in water depths of less than 2000m. The hull-mounted system operates at a frequency of 70–100 kHz and survey planning utilised a swath width of about 3 times water depth throughout operations. The system utilises a drop keel which was raised during extended periods of vessel transit and sampling operations. Data quality deteriorated significantly if the drop keel was not deployed and the data was not recorded.

Six individual survey areas were completed during the course of this cruise within the Summer Isles, Mingulay, Loch Linnhe, Loch Hourn, the Sound of Sleat, and Loch Nevis areas. Sound velocity profiles (SVPs) were collected in each of the six survey areas.

The data recorded will require significant post-cruise processing. One reason for poor-quality data is the presence of air bubbles passing under the ship's hull in poor weather. It should be noted that this problem was not limited to periods of poor sea-state and weather but were also encountered within the sheltered conditions of some sea lochs suggesting additional data quality/acquisition problems.

EM 120 Multibeam Echosounder

The Simrad EM 120 system is designed for high-resolution sea-bed mapping in oceanic water depths but the system can be applied to mapping areas of shallower sea bed. The EM 120 is a lower frequency multibeam system than the EM 710 operating at a frequency of 12 kHz. Survey planning utilised a swath width of about 3 times water depth throughout operations. The EM 120 multibeam system logged many of the transits between survey/sampling areas.

SPB 120 Sub-Bottom Profiler

The SBP 120 sub bottom profiler is an option to the EM 120 multibeam echo sounder. The SBP 120 utilises the EM 120 hydrophone array used to record the return signals, and the EM 120 preamplifier is capable of filtering the received signals into a high-frequency (12 kHz) channel and a low-frequency (2-8 kHz) channel that is fed to the SBP 120 transceiver.

The following parameters were selected as giving a suitable shallow-water image:

Ping Interval (ms)	706
Pulse Form	Linear Chirp
Frequencies (Hz)	2500-7000
Receive Tilt (deg)	0
Transmit Tilt (deg)	0
Beam Spacing (deg)	3
Number of Samples	10855
Source Power (dB)	-30
Pulse Length (ms)	30
Acquisition Delay (ms)	43

Vessel Navigation and the Fusion USBL Acoustic Navigation Software (sonardyne)

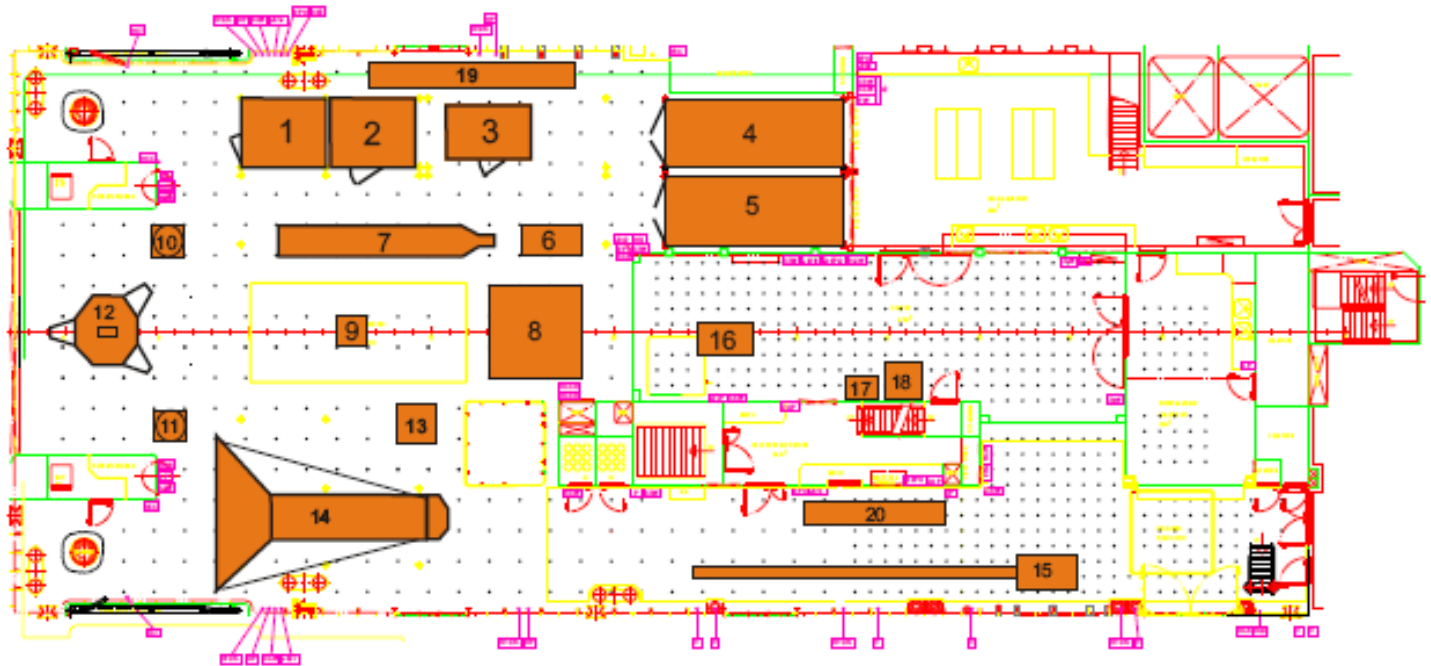
Primary navigation and positioning onboard the *RRS James Cook* is by DGPS. The navigation system has an accuracy of better than 0.5m, exceeding requirements for this cruise. The positional data were run through navigation-logging and display software.

The coordinate system used during the course of this cruise was: **WGS84 UTM zone 30N**.

A USBL (Ultra Short Base Line) transponder was fitted to the rock-drill to record the position of the drill rig relative to the vessel. This worked well on all sites and generally there was <3m offset between the position of the stern of the ship and the drill-rig location on the sea bed. The USBL system has a single transceiver assembly that is pole mounted below the ship and includes a transmit transducer and multiple-receive transducers. The system uses a navigation computer (running on Windows) and a Navigation Controller Unit (NCU).

The central reference point of the vessel was transferred to the A-frame during vibrocoring and the starboard winch during gravity-coring operations (see Figure 11) as no USBL was attached to those items of equipment. Evidence from the comparison of the USBL and stern positions

during rock-drill operations indicated that using the position of the A-frame and starboard winch for locating viborcore and gravity-core sites was accurate for the purposes of this cruise.



- | | |
|---|-------------------------------------|
| 1 15m Rock-Drill Workshop Container | 11 Ratchet Capstan |
| 2 15m Rock-Drill Control Cabin | 12 15m Rock-Drill |
| 3 Vibrocore Control Cabin | 13 Cable Hauler |
| 4 20ft Spares Container | 14 6m Vibrocorer |
| 5 20ft Oriented Drill Storage Container | 15 Gravity Corer Assesmbly |
| 6 Umbillical Winch Power Pack | 16 15m Rock-Drill Core Barrel Bench |
| 7 Vibrocore Core Barrel Handling Bench | 17 1200x1000 Caged Pallet |
| 8 Umbillical Winch | 18 1500x1500 Caged Pallet |
| 9 Tugger Winch | 19 Vibrocore Liner Storage Rack |
| 10 Ratchet Capstan | 20 Gravity Core Liner Storage Rack |

Figure 11 RRS James Cook deck plan.



Figure 12 BGS 15m rock-drill being deployed.



Figure 13 BGS 6m vibrocorer being deployed.



Figure 14 BGS gravity-corer being recovered in the Summer Isles area.

Appendix 4 Cruise Narrative

MOBILISATION

Mobilisation took place in Leith, Edinburgh on the 10th and 11th September. The BGS equipment arrived from Loanhead in four lorry loads. There were delays in mobilising caused by electrical connection problems between the ship supply and the 15m rock-drill, and the removal of a block on the A-frame. All equipment was on board the vessel by 18:00 on the 11th September and the vessel sailed at 09:30 on 12th September 2007.

During mobilisation the BGS Health and Safety Officer, Cathy Russell, visited the vessel to experience the mobilisation of a research ship and assess health and safety practices.

SURVEY

The performance of the 15m rock-drill and poor weather conditions played a key part in the evolution of the cruise plan. The original priority sites on Rosemary and Hatton Banks were not achieved due to poor weather conditions in the Hatton–Rockall region, which prevented the vessel operating safely in the open ocean. Operations therefore concentrated in the sheltered waters of the Inner Hebrides where a programme of sampling had been devised in the Summer Isles, Mingulay, Loch Hourn, Loch Linnhe and Muck areas. The daily logs can be found in [Appendix 6](#) and a breakdown of cruise time in [Appendix 7](#). The cruise is summarised below.

Commissioning and Testing the 15m Rock-drill (12th September – 15th September)

After commissioning, a wet test was carried out in the Moray Firth, and after repairs, two sites located in the Moray Firth, to the east of Wick were successfully drilled with core recovered in both holes. These two sites allowed the deployment and recovery of the 15m rock-drill to be tested and amended to suit the vessel.

Rock-drilling at Nun Rock-Rosemary Bank (15th September – 18th September)

Unfortunately due to adverse weather conditions (Force 8/9, 50+ knot wind speed) operations at both Nun Rock and Rosemary Bank were abandoned. The vessel therefore transited to the Summer Isles area to begin sampling within more sheltered conditions.

Summer Isles Phase 1 (18th September - 23rd September)

Six 15m rock-drill sites and 16 gravity-core sites were completed in the Summer Isles area. It was demonstrated that the rock-drill was capable of drilling through glacial tills achieving greater than 10m penetration in the deepest holes. Although recovery was generally poor, several short (<0.5m) cores of glacial till and ice-rafted boulders and pebbles were recovered. The suite of rock-drill and gravity-core sites has increased the coverage and depth of existing shallow sample sites. Three additional sites to the original programme were cored for high-resolution climate work to be undertaken in conjunction with Glasgow University (SAGES Programme). The long-range weather forecast indicated that conditions in the Hatton–Rockall region remained poor, therefore the vessel transited to Mingulay to continue operations.

Mingulay Phase 1 (23rd September – 27th September)

On site the weather conditions were marginal for sampling with a significant swell resulting in damage to one of the 15m rock-drill legs when the rig was lifted off the sea bed by the swell.

The first drill site visited was sampled successfully with 0.6m of core recovered comprising coral fragments in a fine-grained matrix overlying dolerite. However, the weather deteriorated resulting in the vessel waiting on weather. During this period repairs were made to the rock-drill. Once weather improved two further drill sites were attempted, but problems encountered with the rock-drill, coupled with the presence of unconsolidated sediment and live cold-water coral, resulted in curtailment of operations in the Mingulay area. It should be noted that great care was taken at all three sites to avoid damaging any live coral. Video footage was collected at all sites and the real-time feed used to abort landings and move to a more suitable site when significant live cold-water coral was visible. During the period of weather down time two moorings in the Mingulay area were recovered for SAMS and NIOZ.

Flannan Shelf (27th September – 28th September)

Two rock-drill sites were visited aiming to sample highly magnetic basement. At the first site a glacial till was recovered, however, at the second site 1.69m of granitic gneiss were recovered.

On completion of the second site (+58-08/231) it was discovered that the rock-drill had suffered a hydraulic oil leak with possible water ingress into the hydraulic system. Inspection also showed damage to the frame and legs, caused by landing the rig on a very hard and irregular sea bed in rough sea conditions.

Taking into account the continuing poor weather in the Hatton–Rockall region, as well as the need to repair the rock-drill, the vessel returned to the Summer Isles area where a programme of vibrocoring and multibeam echosounder data acquisition continued.

Summer Isles Phase 2 (28th September – 3rd October)

While repairs continued on the 15m rock-drill, vibrocoring was undertaken with 36 vibrocore sites visited. Better recovery was achieved with the vibrocorer than with the gravity-corer used during Phase 1, such that rock-drill and gravity-core sites visited during Phase 1 were revisited during Phase 2. A multibeam echosounder survey and two sound-velocity profiles (SVPs) were collected in order to extend existing BGS bathymetry data farther into The Minches. The results of this work will add significantly to the Summer Isles area deglaciation research project.

A port call in Ullapool to restock with freshwater allowed the opportunity to repair the damaged 15m rock-drill leg. At this time repairs to the rock-drill were almost complete and the rock-drill was ready for use in the Nun Rock area should weather permit.

Mingulay Phase 2 (3rd October – 4th October)

Eight vibrocore sites were attempted with four sites recovering core. The four successful sites sampled coral fragments within a clay matrix. The cores will allow a follow up research project examining the sedimentary structures and geochemistry of the cores with the aim of determining the age of the cold-water coral reef. Multibeam echosounder and sub-bottom profile data were collected; the multibeam data infilled a gap in existing bathymetric data.

Loch Linnhe (5th October)

This area was sampled for evidence to determine the extent of the Younger Dryas succession within Loch Linnhe. Loch Linnhe represents the site of a major ice stream and data from this area will be compared with data derived from the Summer Isles area. Five lines of multibeam echosounder and sub-bottom data were recorded and, based on these data, five vibrocore sites were chosen. Two sites did not recover any core but three vibrocores recovered a total of 11.48m. It is hoped that the recovered cores contain sediments representing Holocene and Late Glacial successions.

South Muck Depression and Muck Deep (5th October – 6th October)

As the vessel could not operate in Loch Linnhe during the hours of darkness, three sites within the vicinity of the island of Muck were identified using sub-bottom and multibeam data gathered during this cruise. A total of 14.23m of core was collected to test the Holocene and glacial successions in the South Muck Depression and in the Muck Deep.

Loch Hourn, Loch Nevis and the Sound of Sleat (6th October – 7th October)

Two areas at the mouths of Loch Hourn and Loch Nevis were recognised as areas where further evidence to determine the extent of the Younger Dryas succession could be found and to determine the stratigraphy. Seismic and multibeam echosounder data collected in Loch Hourn identified seven suitable sites to sample Holocene and Late Glacial sediments. A total of 28.48m of core were recovered.

A multibeam echosounder survey was undertaken during the hours of darkness in the Sound of Sleat and in Loch Nevis. Due to probable shallow-gas entrained sediments no suitable sites for sampling were identified in the sub-bottom profile and bathymetry data due to the effects of acoustic blanking caused by shallow gas.

Upon completion of sampling and seismic/multibeam survey in this area, the 15m rock-drill was re-commissioned and the vessel began transit to Nun Rock located 28km to the north of Cape Wrath ([Figure 3](#)).

Nun Rock (8th October – 10th October)

Multibeam echosounder data was recently acquired in the area surrounding Nun Rock by the Maritime and Coastguard Agency producing a high-resolution image of the sea-bed morphology. The aim of the sampling programme in the Nun Rock area was to sample the basement rocks expected to crop out in this area. Using the onboard sub-bottom profiler to aid final site selection, 14 sites were visited recovering a total of 17.35m of rock core.

Due to deteriorating weather conditions, operations were halted at 17:20 on the 10th October. The vessel remained on standby in case the opportunity for further sampling arose, but due to prevailing poor weather conditions the vessel left site at 09:30 on the 11th October to transit to Leith for demobilisation.

DE-MOBILISATION (10th October – 13th October)

Demobilisation began during transit from Nun Rock to Leith. The vessel docked in Leith on the 12th October. All sampling equipment was offloaded and transported back to BGS Marine Operations, Loanhead and all core transported to Murchison House on the 13th October. Demobilisation was complete and all personnel were signed off the vessel by 15:00 on the 13th October.

Appendix 5 Health and Safety

The 2007/07 cruise Health and Safety Document provides a comprehensive breakdown of procedures for safe operation of all BGS sampling equipment along with rudimentary vessel health and safety procedures (Smith, 2007). This document was authorised by the BGS Health and Safety Officer prior to the cruise and all members of the scientific party, BGS and non-BGS, read and signed the document. Copies were lodged with the officers and crew of the *RRS James Cook*.

A safety briefing was held aboard the *RRS James Cook* on the 12th September 2007. This was attended by all scientific personnel. Two lifeboat drills were carried out during the cruise (12th and 25th September) and one combined fire drill and lifeboat muster (9th October).

There were no reported health and safety near misses or accidents during the cruise.

Appendix 6 Daily Logs

Note: All times GMT (BST -1 HOUR)

Monday 10th September	
07:00	The following personnel joined the <i>RRS James Cook</i> : Dave Smith <i>Party Chief</i> (Electronic Engineer) Dave Wallis (Electronic Engineer) Neil Campbell (Mechanical Engineer) David Baxter (Mechanical Engineer) Mike Wilson (Electronic Engineer) Alistair Skinner (Drill Operator) Heather Stewart (Geologist, Drill Operator) Julia Crummy (Data Manager, Drill Operator)
07:00-20:00	Mobilisation of vessel in Leith, Edinburgh. Equipment transported from BGS Marine Operations, Loanhead and loaded onto vessel. There were delays in implementing mobilisation caused by electrical connection problems between the ship supply and the drill. A further delay was caused by the time required to remove the jammed block on the A-frame.
Tuesday 11th September	
07:00-20:00	Mobilisation of vessel continued. Remainder of equipment transported from Loanhead and transferred to vessel. The following personnel joined the vessel: Robert Gatliff <i>Chief Scientist Operations Assistant</i> Gavin Elliott (Geologist from the National Oceanography Centre, Southampton) James Bendle (Geochemist from the University of Glasgow) Dan Sinclair (Geochemist from the Scottish Association for Marine Science)
09.00	Meeting with Captain of the <i>RRS James Cook</i> to discuss aims of cruise and how mobilisation was progressing.
Wednesday 12th September	
07:00-20:30	Continue with mobilisation
07:30	<i>RRS James Cook</i> safety briefing by Purser.
08:30	Scientific party meeting to review BGS health and safety procedures, shipboard duties, shifts, aims and objectives of cruise.
09:30	Sail from Leith to position in Firth of Forth to continue with mobilisation of 15m rock-drill.
20:30-23:59	Depart Firth of Forth and transit to Moray Firth.
Thursday 13th September	

00:00-10:30	Transit to Moray Firth, commissioning of 15m rock-drill.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Following shifts will be operated during the cruise: Shift: 00.00-12.00 M. Wilson, A. Skinner, H. Stewart, D. Baxter Shift: 06.00-18.00 G. Elliott, D. Sinclair Shift: 12.00-24.00 D. Smith, R. Gatliff, D. Wallis, N. Campbell Shift: 18.00-06.00 J. Crummy, J. Bendle
10:30-23:15	On test site offshore Banff (57.81668°N, 2.48509°W) continuing work on 15m rock-drill.
16:00	Presentation to Ship's crew on aims and objectives of cruise (R. Gatliff, H. Stewart and G. Elliott).
23:15	Wet test 15m rock-drill. Drill was launched, deployed 5m below sea surface and powered-up briefly before being recovered to deck.
23:30	Drill recovered and launch and recovery procedures assessed.
23:30-23:59	On position for wet test.
Friday 14th September	
00:05	Re-launched 15m rock-drill for further wet testing. Test halted after few minutes and drill recovered to deck.
00:05-14:05	Further maintenance on 15m rock-drill and preparation for deployment.
08:15	Transit to site DL6 located east of Wick in the Moray Firth.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Arrange purchase and delivery to vessel of 4 high-voltage fuses from Wick. Transfer to vessel by pilot boat arranged for Saturday 15 th September.
13:15	Arrive on site DL6 (+58-03/565).
14:05	Deployed drill. Sediment ripples observed on sea bed via cameras on drill. Easy penetration of first core-barrel but operations halted due to malfunctioning water pump.
15.12	First core-barrel retrieved.
15:15	Water pump re-started and drilling re-commenced with new barrel. Rod added and drilling continued with easy penetration to 3.3m below sea bed. Second rod added and drilling halted at 3.89m (TD) below sea bed due to communications problem with drill.
18:22	Drill returned to deck. Problem encountered unloading core-barrels. Vessel transits slowly to site DL7.

22:09	Deploy drill on site DL7 (+58-03/566), water depth 56.5m.
22:27	Drill on sea bed, sandy gravel observed at sea bed. Two core-barrels used and hole terminated at 1.95m below sea bed. Hole abandoned due to loss of water circulation blocking barrel and collapsed hole when re-entry attempted. Problems encountered with rod carousel controls.
22:27-23:59	Drill on sea bed, retracting core-barrel and rod from hole.
Saturday 15th September	
00:00-01:40	Continue recovery of core-barrel and rod from hole. Drill on deck at 01:40.
01:40-23:59	Repair and maintenance work carried out on rock-drill.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
12:30	Leave site DL7 and transit to rendezvous point with Wick Pilot Boat.
14:00	Rendezvous with Pilot Boat to pick up high-voltage fuses and transfer cores from sites DL6 and 7 (+58-03/565 and 566) for pick up by BGS in Wick.
14:30-23:59	Transit from Wick to Nun Rock. Deteriorating weather conditions, high seas expected to the west of the Pentland Firth.
Sunday 16th September	
00:00-01:00	Continue transit to Nun Rock.
01:00	Arrive on site at Nun Rock. Force 8/9 on site therefore transit to Rosemary Bank to take advantage of forecast weather window. Due to inclement weather and high sea-state deck access is forbidden, work on rock-drill postponed.
01:00-16:15	Transit to Rosemary Bank.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
16:15-18:00	Vessel hove to, wind speed >50knots.
18:00-23:59	Continue transit to Rosemary Bank.
Monday 17th September	
00:00-02:10	Transit to Rosemary Bank
02:10	Arrive at Rosemary Bank, wait on weather.
07:00	Meeting with captain to review weather conditions and forecast. Very poor five day forecast, decide to wait on next forecast update at 10:30. Plan to transit to sheltered waters of the Summer Isles area should 10:30 forecast remain marginal.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
10:00	Improved weather conditions and sea-state. Transit to HS6 on northern flank of Rosemary Bank.
11:00	On site HS6 and sea-state deemed adequate for safe launch of rock-drill.

11:00-12:03	Rock-drill prepared for launch.
12:04	Deploy drill on site HS6, water depth 963m.
12:30	Rock-drill recovered to deck due to a communications failure and a large amount of snatch on the cable which was deemed enough to put the equipment at considerable risk. Conditions deteriorating and vessel begins transit to Summer Isles area.
12:30-23:59	Transit to Summer Isles area.
Tuesday 18th September	
00:00-03:00	Continue transit to Summer Isles area, conditions deemed to poor to consider attempt at Nun Rock.
09:00	On site SI50 (+57-06/253), deployed drill but had to recover again due to failure of vessels dynamic positioning (DP). Repairs made to 15m rock-drill.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Weather forecast poor therefore plan to continue operations in the sheltered waters of the Summer Isles area. Discussion by scientific party as to alternative work programme.
14:50	Redeploy drill.
18:18	Drill on deck with no recovered core. Repairs required to rock-drill.
22:34	Deploy drill on site SI50 (+57-06/254).
22:34-23:59	On site SI50.
Wednesday 19th September	
00:00-12:23	Continue drilling on site SI50 (+57-06/254).
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
12:23	Drill on deck. Man-overboard recovery vessel deployed on exercise from <i>RRS James Cook</i> .
14:45	Drill deployed on site SI 51 (+57-06/255). Drilled to 5.1m (TD).
20:10	Drill on deck, transit to next site.
22:33	Deployed drill on site SI 49 (+57-06/256).
22:33-23:59	On site SI49.
Thursday 20th September	
00:00-09:29	On site SI49.
09:29	Drill on deck. Transit to next site and prepare BGS gravity-corer for deployment.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
11:45	Deploy 10m gravity-corer on site SI40 (+57-06/257CS). Although gravity-corer successfully deployed with 10m barrel, only recovered 3.26 m of sediment.
12:30	Deploy 10m gravity-corer on site SI40 (+57-06/258CS) for repeat core, slower rate of penetration achieved. Held on sea floor fully deployed for 2 minutes. Recovered

	3.37m sediment. Slow manoeuvre of vessel due to prevalence of fishing gear during transit to next site.
13:30	On transit to site SI64 at head of loch, presence of fishing gear impedes vessel progress, vessel manoeuvres around obstructions.
14:05	Deploy 10m gravity-corer on site SI61 (+57-06/259CS). Recovered 3.65m of sediment. Transit to next site
15:03	Deploy 10m gravity-corer on site SI62 (+57-06/260CS). Recovered 3.59m of sediment. Transit to next site.
16:11	Deploy 10m gravity-corer on site SI63 (+57-06/261CS). Hard impact at sea bed ruptured core-barrel, no sample recovered.
16:30	Reviewed gravity-coring strategy. Decide to return to 15m rock-drill. Transit to site SI46.
18:00	On site SI46, waiting on weather, Force 9 forecast with recorded wind speed of 40knots on site. No operations due to adverse weather.
19:30	Weather and sea-state diminishing but captain of vessel advises no deployment of equipment until next weather forecast. Plan revised to i) complete rock-drill and gravity-core sites in Summer Isles area, and ii) assess long-range weather forecast with a view to proceed to Mingulay at earliest opportunity before heading onto Hatton Bank or the North Channel (northern Irish Sea) subject to science review.
19:30-23:59	Wait on weather.
Friday 21st September	
00:10	Bridge give permission to deploy rock-drill.
00:30	Weather deteriorated therefore operations postponed. Wait on weather.
03:00	Drill deployed on site SI46 (+57-06/262)
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Captain told us that there is a potential weather window in the next few days and advises a review of planned operations once operations completed in the Summer Isles area. Captain agrees to purchase Admiralty Charts for the Skye-Rhum area for alternative science objectives should the weather for Hatton Bank remain poor. Royal Navy NATO exercise in area restricts <i>RRS James Cook</i> operations to the Summer Isles area for the next 24 hours.
19:10	Drill on deck at site SI46. Transit to site SI47.
20:29	Drill deployed on site SI47 (+57-06/263).
20:29-23:59	On site (+57-06/263).
Saturday 22nd September	
00:00-10:10	On site (+57-06/263).
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
10:10	Drill on deck for site SI47 (+57-06/263), TD 10.26m. Transit into Loch Broom.
10:20	Deploy man-overboard vessel to retrieve Skye-Rhum area Admiralty Charts. Transit to head of Loch Broom for gravity-coring.

12:40	Deploy 10m gravity-corer on site SI53 (+57-06/264CS). Recovered 2.68m of sediment. Hold station.
13:31	Deploy 10m gravity-corer again on site SI53 (+57-06/265CS). Recovered 2.44m of sediment. Transit to next site.
14:09	Deploy 10m gravity-corer on site SI52 (+57-06/266CS). Recovered 1.67m of sediment. Hold station.
14:38	Deploy 10m gravity-corer again on site SI52 (+57-06/267CS). Recovered 1.71m of sediment. Transit to next site.
15:51	Deploy 10m gravity-corer on site SI39 (+57-06/268CS). Recovered 2.89m of sediment. Transit to next site.
16:37	Deploy 10m gravity-corer on site SI54 (+57-06/269CS). Recovered 2.37m of sediment. Transit to next site.
17:27	Deploy 10m gravity-corer on site SI41 (+57-06/270CS). Recovered 3.11m of sediment. Transit to next site.
18:54	Deploy 15m rock-drill on site SI48 (+57-06/271).
18:54-23:59	On site SI48 (+57-06/271).
Sunday 23rd September	
00:00-05:30	On site SI48 (+57-06/271).
05:30	Drill on deck for site SI48 (+57-06/271). Transit to site JB3 (+57-06/272CS) for gravity-coring.
08:10	Deploy 10m gravity-corer on site JB3 (+57-06/272CS). Recovered 3.05m of sediment. Transit to next site.
09:21	Deploy 10m gravity-corer on site SI42 (+57-06/273CS). Recovered 3.34m of sediment. Transit to next site.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
10:37	Deploy 10m gravity-corer on site JB2 (+57-06/274CS). Recovered 3.14m of sediment. Transit to next site.
12:00	Deploy 10m gravity-corer on site SI44 (+57-06/275CS). Recovered 3.24m of sediment.
14:05	Operations complete in the Summer Isles area, transit to Mingulay.
14:05-23:59	Transit to Mingulay.
Monday 24th September	
00:00-03:05	Transit to site DL1, Mingulay.
03:05	On site, 15m rock-drill deployed on site DL1 (+56-08/927).
04:25	First core-barrel complete.
05:00	Large swell lifts rock-drill off sea bed during drilling operations. After check of systems, no obvious damage recorded.

05:22	A second large swell lifts drill rig off sea bed and tips it over. Decide to retract core-barrel and recover drill.
06:00	Drill on deck for site DL1 (+56-08/927), damage to leg 3 and the USBL bracket. Weather marginal for continuing drilling operations. Decide to recover SAMS mooring.
08:00	Recover SAMS mooring.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Options for continuing operations reviewed. Remain on site until weather improves as forecast is favourable.
10:24	Recover NIOZ mooring.
11:00	Transit to DL10. Wait on weather.
11:00-23:59	Wait on weather.
Tuesday 25th September	
00:00-11:33	Wait on weather.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Decision to remain on site as weather continues to improve. Forward plan made to complete operations at Mingulay before transiting to Flannan.
11:30	Meeting with BGS marine operations and deck crew to review method for deploying and retrieving 15m rock-drill.
11:33	On site DL10, deploy rock-drill.
12:15	Electrical fault with rock-drill combined with lack of suitable site for landing rig. >5° slope angle and live cold-water corals and sponges makes site unsuitable for landing rig for drilling.
12:15-23:59	Repair work on 15m rock-drill.
Wednesday 26th September	
00:00-03:00	Continue repairs to 15m rock-drill.
03:00	On site DL10 (+56-08/928), 15m rock-drill deployed. Vessel manoeuvring (4 times) to find suitable site for landing drill considering slope angle and habitat destruction.
06:00	Problems encountered with electronics/valve controls.
06:55	Drill on deck for repairs.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
12:00	Transit to site DL1 and begin sub-bottom data survey to choose better sample sites. New site chosen with estimated 4-5m sediment cover on top of bedrock.
14:00	On site DL11 (+56-08/929). Procedure followed to ensure no destruction of habitat with drill rig, suitable site found with second landing attempt. Operations halted due to further electrical problems.
15:00	Drill on deck, base of rig covered in dead coral fragments in a fine-grained muddy matrix, evidence that rig sunk into the unconsolidated sediment on the sea floor.

15:00-23:59	Continue with repairs to rock-drill.
Thursday 27th September	
00:00-18:00	Continue with repairs and maintenance to rock-drill
07:51	Depart Mingulay and transit to Flannan.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
18:00	Arrive on site JDR13 (+57-08/487).
18:22	Deployed rock-drill on site JDR13, sea bed observed comprised rippled coarse sediment.
20:04	Drill on deck for site JDR 13 (+57-08/487), transit to site JDR11.
21:50	On site JDR11 (+58-08/231).
22:16	Deployed drill on site JDR11 (+58-08/231).
22:16-23:59	Attempting to located suitable site for the rock-drill due to rocky, uneven sea bed.
Friday 28th September	
00:00-00:16	Continuing to locate suitable site to land rock-drill.
00:16	Rock-drill on sea floor for site JDR11 (+58-08/231), begin drilling.
05:15	Drill on deck for site JDR11 (+58-08/231).
05:30	Begin transit to Rosemary Bank.
06:00	Hove to at 58.08216°N, 7.86186°W, realised that the rock-drill has a hydraulic oil leak and requires maintenance and repair. Transit to Ullapool to exchange the position of the rock-drill for the vibrocorer.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
18:44-23:59	Arrive in the Summer Isles area and begin exchange of the rock-drill for the vibrocorer.
Saturday 29th September	
00:00-08:15	Commissioning vibrocorer and repair work on rock-drill.
08:15	Transit to site SI57. Continue commissioning vibrocorer.
09:27	Deploy vibrocorer on site SI57 (+57-06/277VE).
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
10:00	Vibrocorer on deck. Transit to next site.
10:07	On site SI58.
10:16	Deploy vibrocorer on site SI58 (+57-06/278VE).
10:37	Vibrocorer on deck). Transit to next site.
10:50	On site SI59
11:16	Deploy vibrocorer on site SI59 (+57-06/279VE).

11:36	Vibrocorer on deck. Transit to next site.
12:15	Deploy vibrocorer on site SI48 (+57-06/271VE).
12:25	Vibrocorer on deck. Transit to next site.
12:59	On site SI47.
13:00	Deploy vibrocorer on site SI47 (+57-06/263VE).
13:25	Vibrocorer on deck. Transit to next site.
13:53	On site at SI46 (+57-06/262VE).
13:57	Carry out sea calibration for depth of penetration sub-bottom profiler display. Results indicate that the scale on display is 0.6m-6.5m (equivalent to 0m (sea bed) to 6 m maximum penetration).
14:16	Deploy vibrocorer on site SI46 (+57-06/262VE).
14:32	Vibrocorer on deck. Transit to next site.
15:30	On site SI45 (+57-06/280VE).
15:35	Deploy vibrocorer on site SI45 (+57-06/280VE).
15:49	Vibrocorer on deck. Transit to next site.
16:26	On site JB3.
16:27	Deploy vibrocorer on site JB3 (+57-06/272VE).
16:46	Vibrocorer on deck. Transit to next site.
17:10	On site SI42.
17:19	Deploy vibrocorer on site SI42 (+57-06/273VE).
17:39	Vibrocorer on deck. Transit to multibeam area northwest of the Summer Isles area.
18:42	Carry out SVP to 100m water depth.
18:52	Recover SVP and download data.
19:10	Transfer SVP data to EM710. Problems encountered by <i>RRS James Cook</i> survey team with the multibeam system accepting the SVP data.
19:30-23:59	On site for multibeam echosounder calibration lines. <i>RRS James Cook</i> and BGS marine operations personnel working on calibrating the multibeam system and repairs to the rock-drill respectively.
Sunday 29th September	
00:00-06:00	Repair work to rock-drill. Carry on with the multibeam system calibration.
06:00	Transit to site SI56.
07:00	On site SI56.
07:19	Deploy vibrocorer on site SI56 (57-06/281VE).
07:44	Vibrocorer on deck. Transit to next site.
09:14	On site SI64. Deploy vibrocorer on site SI 64 (+57-06/282VE).
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
09:40	Vibrocorer on deck. Transit to next site.

10:19	On site SI40. Deploy vibrocorer on site SI 40 (+57-06/258VE).
10:42	Vibrocorer on deck. Transit to next site.
11:17	On site SI63. Deploy vibrocorer on site SI 63 (+57-06/261VE).
11:35	Vibrocorer on deck. Transit to next site.
12:08	Vibrocorer on deck. Redeploy vibrocorer on site SI63 (+57-06/283VE) as suspect struck cobble at base of +57-06/261VE halting penetration.
12:22	Vibrocorer on deck. Transit to next site.
13:00	On site SI62. Deploy vibrocorer on site SI 62 (+57-06/260VE).
13:18	Vibrocorer on deck. Transit to next site.
14:00	On site SI68. Deploy vibrocorer on site SI 68 (+57-06/284VE).
14:16	Vibrocorer on deck. Transit to next site.
14:48	On site SI69. Deploy vibrocorer on site SI 69 (+57-06/285VE).
15:02	Vibrocorer on deck. Transit to next site.
15:30	On site SI61. Deploy vibrocorer on site SI 61 (+57-06/259VE).
15:47	Vibrocorer on deck. Transit to next site.
16:19	On site SI60. Deploy vibrocorer on site SI 60 (+57-06/286VE).
16:46	Vibrocorer on deck. Transit to next site.
17:26	On site JB2. Deploy vibrocorer on site JB2 (+57-06/274VE)
17:50	Vibrocorer on deck. End of vibrocoring for the day, transit to multibeam survey area.
19:33	Start first calibration line for multibeam echosounder system.
19:33- 23:59	Summer Isles area multibeam echosounder survey.
Monday 1st October	
00:00- 02:45	Continue with the multibeam echosounder survey in the Summer Isles area. Continue repairs to rock-drill.
02:45- 06:00	Vessel holding station as problems encountered with calibration of multibeam system. Continue repairs to rock-drill.
06:00	Transit to site SI43.
06:53	On site SI43. Deploy vibrocorer on site SI43 (+57-06/287VE).
07:29	Vibrocorer on deck. Transit to next site.
07:52	Hold station on transit to site SI44 as possible entanglement of ship's rudder with fishing buoy ropes. Man-overboard boat launched with <i>RRS James Cook</i> crew to examine rudder. Rope successfully removed.
08:20	After review of sites with Captain, sites SI44 and SI55 abandoned due do proximity of fishing buoys.
08:45	On site SI49. Deploy vibrocorer on site SI 49 (+57-06/256VE), low penetration.
09:10	Vibrocorer on deck.
09:25	Redeploy vibrocorer on site SI49 (+57-06/288VE).

09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
09:54	Vibrocoring on deck. Transit to next site.
10:25	On site JB1. Deploy vibrocoring on site (+57-06/276VE).
10:55	Vibrocoring on deck. Transit to next site.
13:00	On site SI41. Deploy vibrocoring on site SI41 (+57-06/270VE).
13:18	Vibrocoring on deck. Transit to next site.
13:57	On site SI54. Deploy vibrocoring on site SI54 (+57-06/269VE).
14:15	Vibrocoring on deck. Transit to next site.
14:58	On site SI39. Deploy vibrocoring on site SI39 (+57-06/268VE).
15:30	Vibrocoring on deck. Transit to next site.
17:40	On site SI51. Deploy vibrocoring on site SI51 (+57-06/255VE).
18:08	Vibrocoring on deck. Transit to next site.
18:43	On site SI50. Deploy vibrocoring on site SI 50 (+57-06/254VE).
19:25	End vibrocoring for the day.
20:00	Captain decides to hold position in Loch Ewe until first light as failing light increases the risk of hitting fishing buoys to unacceptable level. Continue repair work on rock-drill and fit camera and light to vibrocoring.
Tuesday 2nd October	
00:00-06:00	Continue work on rock-drill while holding station in Loch Ewe.
06:00	Transit from Loch Ewe to Ullapool.
08:00	Arrive in Ullapool. <i>RRS James Cook</i> begins to take on fresh water, blacksmith arrives to carry out repairs to Leg 3 of the rock-drill.
11:30	Vessel departs from Ullapool and transits to head of Loch Broom to continue the vibrocoring programme.
13:00	Arrive on site SI53. Deploy vibrocoring on site SI53 (+57-06/264VE).
12:39	Vibrocoring on deck. Transit to next site.
13:04	On site SI52. Deploy vibrocoring on site SI52 (+57-06/267VE).
13:17	Vibrocoring on deck. Transit to next site.
13:34	On site RG1. Deploy vibrocoring on site RG1 (+57-06/289VE).
13:50	Vibrocoring on deck. Transit to next site.
14:22	On site SI65. Deploy vibrocoring on site SI65 (+57-06/290VE).
14:43	Vibrocoring on deck. Transit to next site.
15:49	On site SI66. Deploy vibrocoring on site SI66 (+57-06/291VE). Strands of wire armour observed to be broken on the winch cable. Cable re-terminated once the vibrocoring back on deck.
16:04	Vibrocoring programme in the Summer Isles area completed. Transit to the multibeam echosounder survey area to continue survey.
17:37-	Continue multibeam echosounder survey. Continue repairs to rock-drill and re-

23:59	termination of vibrocorer.
Wednesday 3rd October	
00:00-14:00	Continue with multibeam echosounder survey, vibrocorer re-termination and repairs to rock-drill. Paint base of vibrocorer black to reduce reflection for photography.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
14:00	Vessel holding station to carry out a SVP and to test the re-termination of the vibrocorer.
15:18-18:50	Resume multibeam echosounder survey.
18:50-23:59	End multibeam survey and transit to Mingulay. Repairs continue to rock-drill.
Thursday 4th October	
00:00-04:49	Continue transit to Mingulay. Leg 3 refitted to rock-drill.
04:49	Arrive on site DL11. Deploy vibrocorer on site (+56-08/929VE).
05:33	Vibrocorer on deck. Transit to next site.
06:04	On site DL12. Deploy vibrocorer on site DL12 (+56-08/ 934VE). Manoeuvred vessel to optimum site for DL12 so no destruction of live cold-water coral.
06:45	Vibrocorer on deck. Transit to next site.
06:50	Camera and barrel retract functions not working on vibrocorer. Recover vibrocorer to deck and carry out repairs.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
10:02	On site DL13. Deploy vibrocorer on site DL13 (+56-08/930VE). Manoeuvred vessel to optimum site for DL13 so no destruction of live cold-water coral.
10:41	Vibrocorer on deck. Transit to next site.
11:09	On site DL14. Deploy vibrocorer on site DL14 (+56/08/931VE). Abandoned site due to abundance of live cold-water coral. This site has video data associated with it so retain sample number.
11:34	Vibrocorer on deck. Transit to next site.
12:05	On site DL15. Deploy vibrocorer on site DL15 (+56-08/932VE). Only achieved 1m penetration therefore assume reached bedrock.
12:25	Vibrocorer on deck. Transit to next site.
12:54	On site DL16. Deploy vibrocorer on site DL16 (+58-06/933VE). Only achieved 1m penetration therefore assume reached bedrock.
13:11	Vibrocorer on deck. Transit to next site. At next site collect reconnaissance sub-bottom profile data to help with positioning of next site.
13:22	On site DL17. Deploy vibrocorer on site DL17 (+58-08/935VE).
13:40	Vibrocorer on deck. Transit to next site.
13:44	On site DL18. Deploy vibrocorer on site DL18 (+58-08/936VE). Spooling chain on vibrocorer barrel winch broken.

14:34	Vibrocorer on deck. Transit to multibeam echosounder survey area ready to carry out a SVP. Carry out repair to spooling chain on vibrocorer barrel winch.
15:30-15:51	Carry out a SVP.
16:30	Complete upload of SVP data and calibration of multibeam echosounder systems. Begin multibeam echosounder survey in Mingulay area. Data quality observed to be very poor although favourable weather and sea-state.
22:25	End of multibeam echosounder survey and sampling operations in Mingulay.
22:30-23:59	Transit to Loch Linnhe. Continue repairs to rock-drill.
Friday 5th October	
00:00-07:00	Transit to Loch Linnhe. Continue repairs to rock-drill.
07:00	Arrive on site in Loch Linnhe. Deploy SVP.
07:30	SVP complete, recovered to deck.
08:11	Begin multibeam echosounder and sub-bottom profiler survey in Loch Linnhe, these data will be used to select sampling sites in the loch.
09:00	Test main motor and pump on rock-drill whilst continue survey.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
11:24	Multibeam echosounder and sub-bottom profiler survey complete in Loch Linnhe. Transit to site LL4.
12:06	On site LL4. Deploy vibrocorer on site LL4 (+56-06/170VE).
12:26	Vibrocorer on deck. Transit to next site.
12:46	On site LL3. Deploy vibrocorer on site LL3 (+56-06/171). Slope angle too high therefore abandoned site.
12:59	Vibrocorer on deck. Transit to next site acquiring sub-bottom profiler data en route.
13:10	On site LL2. Deploy vibrocorer on site LL2 (+58-06/172VE). Hard sea bed encountered, move rig 10m away from this position, penetrated 0.4m, no recovery.
13:31	Vibrocorer on deck. Transit to next site.
13:58	On site LL1. Deploy vibrocorer on site LL1 (+56-06/173VE).
14:15	Vibrocorer on deck. Transit to next site.
14:40	On site LL5. Deploy vibrocorer on site LL5 (+56-06/173VE).
	Vibrocorer on deck. Transit to start of next multibeam echosounder and sub-bottom profiler survey line.
15:28-16:27	Continue with multibeam echosounder and sub-bottom profiler survey in Loch Linnhe.
16:27	Complete operations in Loch Linnhe, transit to South Muck area.
21:17	Arrive on site in South Muck area, start multibeam echosounder data collection. This is a transit line with no SVP data collected.
23:00	Continue transit to site JH2.

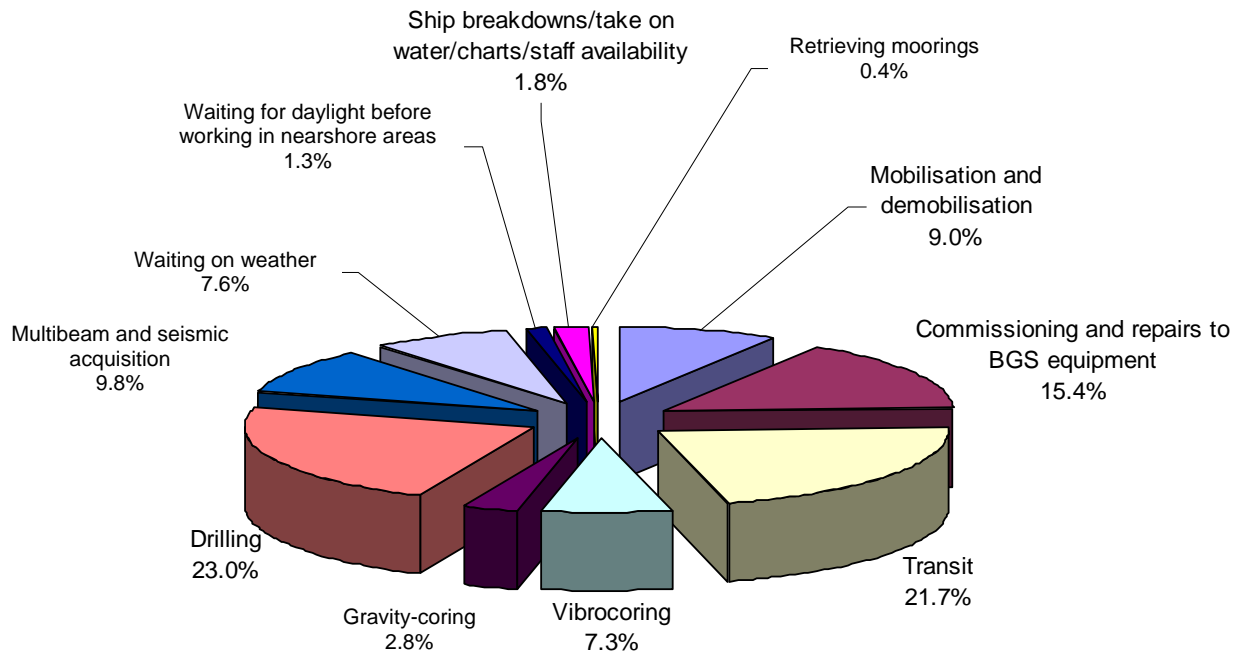
23:39	On site JH2. Deploy vibrocorer on site JH2 (+56-07/726VE).
Saturday 6th October	
00:05	Vibrocorer on deck. Transit to next site (JH6, Muck Deep).
01:27	At start of reconnaissance multibeam echosounder and sub-bottom profiler line through JH6 and JH5 to confirm ground conditions and optimum position of sites.
02:06	End of survey line, revised final position for JH6.
02:49	On site JH6. Deploy vibrocorer on site JH6 (+56-07/727VE).
03:14	Core-barrel retractor on vibrocorer failed. Manually retract barrel on recovery to deck.
03:30	Repairs carried out to vibrocorer.
05:10	Transit to site JH5.
05:21	On site JH5. Deploy vibrocorer on site JH5 (+56-07/728VE).
05:55	Vibrocorer on deck. End of operations in island of Muck region. Transit to Loch Hourn via a potential multibeam echosounder area located to the north of Eigg. Assess suitability of area for night survey work.
09:10	Arrive at mouth of Loch Hourn. Deploy SVP.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel.
09:55	SVP recovered, begin multibeam echosounder and sub-bottom profiler survey in Loch Hourn.
12:50	Enter head of Loch Hourn, begin programme of vibrocoring.
13:09	On site LH1. Deploy vibrocorer on site LH1 (+57-06/292VE).
13:26	Vibrocorer on deck. Transit to next site.
13:41	On site LH2. Deploy vibrocorer on site LH2 (+57-06/293VE).
13:57	Vibrocorer on deck. Transit to next site.
14:13	On site LH3. Deploy vibrocorer on site LH3 (+57-06/294VE).
14:31	Vibrocorer on deck. Transit to next site.
14:45	On site LH4. Deploy vibrocorer on site LH4 (+57-06/295VE).
15:03	Vibrocorer on deck. Transit to sites NG2 and NG3 acquiring multibeam echosounder and sub-bottom profiler data en route.
15:29	On site LH5 (near NG2). Deploy vibrocorer on site LH5 (+57-06/296VE).
15:47	Vibrocorer on deck. Transit southeast into the loch.
16:17	On site LH6. Deploy vibrocorer on site LH6 (+57-06/297VE).
16:42	Vibrocorer on deck. Transit southeast into the loch.
16:59	On site LH7. Deploy vibrocorer on site LH7 (+57-06/298VE).
17:00	Transit out of Loch Hourn acquiring multibeam echosounder and sub-bottom profiler data en route.
17:54-23:59	Begin multibeam echosounder and sub-bottom profiler survey in the Sound of Sleat at the mouth of Loch Hourn.

Sunday 7th October	
00:00-06:20	Continue multibeam echosounder and sub-bottom profiler survey in the Sound of Sleat at the mouth of Loch Hourn.
06:20	End survey in Sound of Sleat and transit to Loch Nevis.
08:01	Begin multibeam echosounder and sub-bottom profiler survey in Loch Nevis.
09:30	Daily briefing meeting between BGS scientific party and vessel personnel. Forecast indicates favourable drilling conditions at Nun Rock.
11:10	Complete survey in Loch Nevis. No sampling programme carried out in Loch Nevis, transit to Loch Scavaig to exchange vibrocorer for the 15m rock-drill.
11:10	Continue collection of EM120 multibeam echosounder and sub-bottom profiler data on approach to Loch Scavaig but stop collecting EM710 as drop keel raised.
12:59	Stop logging EM120 multibeam echosounder and sub-bottom profiler data on approach to Loch Scavaig.
13:00	BGS marine operations team prepare to exchange equipment on the back deck while vessel moves into position in Loch Scavaig.
13:30	Vessel holding position in Loch Scavaig, begin exchange of vibrocorer for rock-drill.
16:30	Heavy lifting phase of equipment transfer complete allowing vessel to begin transit to Nun Rock.
16:30-23:59	Transit to Nun Rock. Re-commissioning of rock-drill continues.
Monday 8th October	
00:00-07:20	Transit to Nun Rock.
07:20	Arrive on site JDR3. Sub-bottom profiler data acquired over site to confirm suitable ground conditions.
07:57	On site JDR3 (+58-05/389), deploy rock-drill.
09:34	Drill on deck for site JDR3 (+58-05/389). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
11:15	On site JDR5 (+58-05/390), deploy rock-drill.
14:02	Drill on deck for site JDR5 (+58-05/390). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
16:32	On site JDR6 (+58-05/391), deploy rock-drill.
17:55	Drill on deck for site JDR6 (+58-05/391). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
19:19	On site JDR14 (+58-05/392), deploy rock-drill.
21:05	Drill on deck for site JDR14 (+58-05/392). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
21:19	Re-visit site JDR14 (+58-05/393), deploy rock-drill.
22:24	Drill on deck for site JDR14 (+58-05/393).
22:24-23:59	Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.

Tuesday 9th October	
00:12	On site JDR15 (+58-05/394), deploy rock-drill.
14:02	Drill on deck for site JDR15 (+58-05/394). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
11:15	On site JDR17 (+58-05/395), deploy rock-drill.
14:02	Drill on deck for site JDR17 (+58-05/395). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
16:00	On site JDR4 (+58-05/397), deploy rock-drill.
18:55	Drill on deck for site JDR4 (+58-05/397). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
20:10	On site JDR18 (+58-05/398), deploy rock-drill.
23:50	Drill on deck for site JDR18 (+58-05/398).
23:50- 23:59	Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
Wednesday 10th October	
00:00- 01:50	Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
01:50	On site JDR7 (+59-05/317), deploy rock-drill.
10:27	Drill on deck for site JDR7 (+59-05/317). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
11:51	On site JDR8 (+59-06/395), deploy rock-drill.
12:24	Rock-drill falls over on sea bed. Using winch lift rock-drill off sea bed. Abandon site JDR8 (+59-06/395) after failure to find suitable site, no recovery.
12:41	Rock-drill not recovered to deck but lifted off sea bed, allowed to settle in water column and lowered back onto the sea bed in a position approximately 20m away from abandoned site +59-06/395. This site has a sample number of +59-06/396.
14:20	Drill on deck for site JDR8 (+59-06/396). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
14:58	On site JDR9 (59-06/397), deploy rock-drill.
17:20	Drill on deck for site JDR9 (59-06/397). Transit to next site and carry out reconnaissance sub-bottom profiler data acquisition over drill site.
19:00	On site JDR9. Vessel waiting on weather.
19:00- 23:59	Waiting on weather.
Thursday 11th October	
00:00- 09:30	On station JDR9, waiting on weather. Wind speed 30-35 knots, gusting 40+ knots.
06:20	Hove to, dynamic positioning thrusters switched off as unable to hold position on site in deteriorating weather conditions.
09:30	End of scientific operations for 2007/07. Vessel begins transit to Dunnett Head and from there onwards to Leith, Edinburgh.

09:30-20:00	Demobilisation of all BGS equipment begins.
Friday 12th October	
00:00-15:00	Transit to Leith, Edinburgh.
07:00-15:00	Continue BGS equipment demobilisation.
15:00	Vessel docked in Leith, Edinburgh.
Saturday 13th October	
07:00	Dockside crane and transport to take equipment from the vessel to Loanhead, Edinburgh arrive.
07:00-15:00	Unloading of all BGS equipment from <i>RRS James Cook</i> and transport to Loanhead. Transport cores from vessel to Murchison House cold store.
15:00	Unloading of all cores complete at Murchison House.
15:30	Unloading of all equipment at Loanhead complete.

Appendix 7 BGS Cruise 2007/07 Time Use Chart



Glossary

NIOZ Royal Netherlands Institute for Sea Research (www.nioz.nl).

SAMS Scottish Association for Marine Science (www.sams.ac.uk).

References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: <http://geolib.bgs.ac.uk>.

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