RRS JAMES CLARK ROSS
CRUISE REPORT – JR175 West Greenland and Baffin Bay

"Marine geophysical and geological investigations of past flow and stability of a major Greenland ice stream in the late Quaternary"

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View east towards mouth of Jakobshavns Isfjord, August 15, 2009

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1. CRUISE JR175 WEST GREENLAND AND BAFFIN BAY

1.1 Acknowledgements

We thank the Master, Officers and Crew of the RRS *James Clark Ross* for excellent support throughout Cruise JR175, August-September 2009. The work was funded by NERC.

1.2 Scientific Background, Aims and Achievements

The overall scientific goal of this project is to reconstruct the Late Quaternary behaviour of the fastest ice stream to drain the modern Greenland Ice Sheet: Jakobshavns Isbrae (JAKIB) in central west Greenland. JAKIB drains one of the largest basins of the Greenland Ice Sheet (390,000 km^2), flows at about 12 km per year and accounts for about 7% of the total ice discharge from the ice sheet. It exerts a major influence on the contemporary mass-balance, and is likely to have had a similar influence in the past. Recent observations from the Greenland Ice Sheet have shown that some the fast flowing ice streams (including JAKIB) which drain the ice sheet into the surrounding ocean are thinning, speeding up and in some cases their floating margins are disintegrating. The ice streams are important because they are responsible for most of ice discharged from the Greenland Ice Sheet today and would have played a similar important role in the past. Furthermore they are the main mechanism by which icebergs and meltwater are delivered to the ocean and therefore affect ocean circulation and, through this, climate. Computer simulations of the effects of melting of the Greenland Ice Sheet on the North Atlantic have shown that the freshwater runoff produced by this melting could seriously weaken or even stop the thermohaline circulation. It is therefore important to understand if these recent dynamic changes to the Greenland Ice Sheet are part of a longer-term natural cycle or a response to solely recent climate change. Key to resolving this question is an understanding of the longer-term changes in ice sheet behaviour during the Late Quaternary.

The aim of cruise JR175 to the West Greenland continental margin and Baffin Bay was to collect blocks of marine geophysical data using EM120 multibeam swath bathymetry and sub-bottom profiling, as well as transects of sediment cores using vibro-, box, and gravity coring from the continental shelf, slope and adjoining deep-sea basin offshore of Jakobshavns Isbrae in order to answer a number of scientific questions including: How long has this ice stream been in existence; what were it's dimensions during past glaciations and particularly the LGM? When and how rapidly did it last retreat from the continental shelf of Greenland? What are the processes responsible for the high flow velocities of this ice stream and what are the major controls on its location? What is the nature of sedimentation associated with Jakobshavns Isbrae; and has it undergone large-scale collapse prior to modern times?

The study area for JR175 was the continental shelf and slope offshore of Disko Bay and the Vaigat, central west Greenland, as well as the trough mouth fan and adjoining shelf offshore of Umanak Fjord to the north (Figures 1 and 2). In addition, geophysical and geological investigations were carried out in Igdlorssuit Sund and Karrats Isfjord as far as the front of Rinks Glacier and the deep sea abyssal plain of Baffin Bay offshore of the Diko and Umanak fans (Figures 1 and 2). The work, funded by NERC, involved collaboration between Durham (lead institution) and Cambridge universities as well as a number of UK and international collaborators including the Institute of Arctic and Alpine Research at the University of Colorado (USA), University Centre in Svalbard (Norway), University of Loughborough (UK), GEOTOP and the Université du Quebec à Montréal (Canada).

The main datasets acquired on cruise JR175 during 39 science days, from 4 August to 11 September 2009, were (see Figures 2, 3 and 4):

- Swath and TOPAS data, vibro- and box cores, and CTDs from the Disko Trough Mouth Fan and adjoining continental shelf offshore of Disko Bugt
- Swath and TOPAS data, vibro- and box cores and CTDs from Disko Bugt and the Vaigat.
- Swath and TOPAS data, a gravity core, box core, and CTD from a deep sea transect from the lower Disko Fan to the lower Umanak Trough Mouth Fan.
- Swath and TOPAS data, vibro- and gravity cores from the continental shelf offshore of Umanak Fjord.
- Swath and TOPAS data, vibro- and gravity cores and CTDs from Umanak Fjord, Igdlorssuit Sund, Karrats Isfjord and the front of Rinks Glacier.
- Swath and TOPAS data during passage to and from the study area along the west Greenland continental shelf and upper slope.

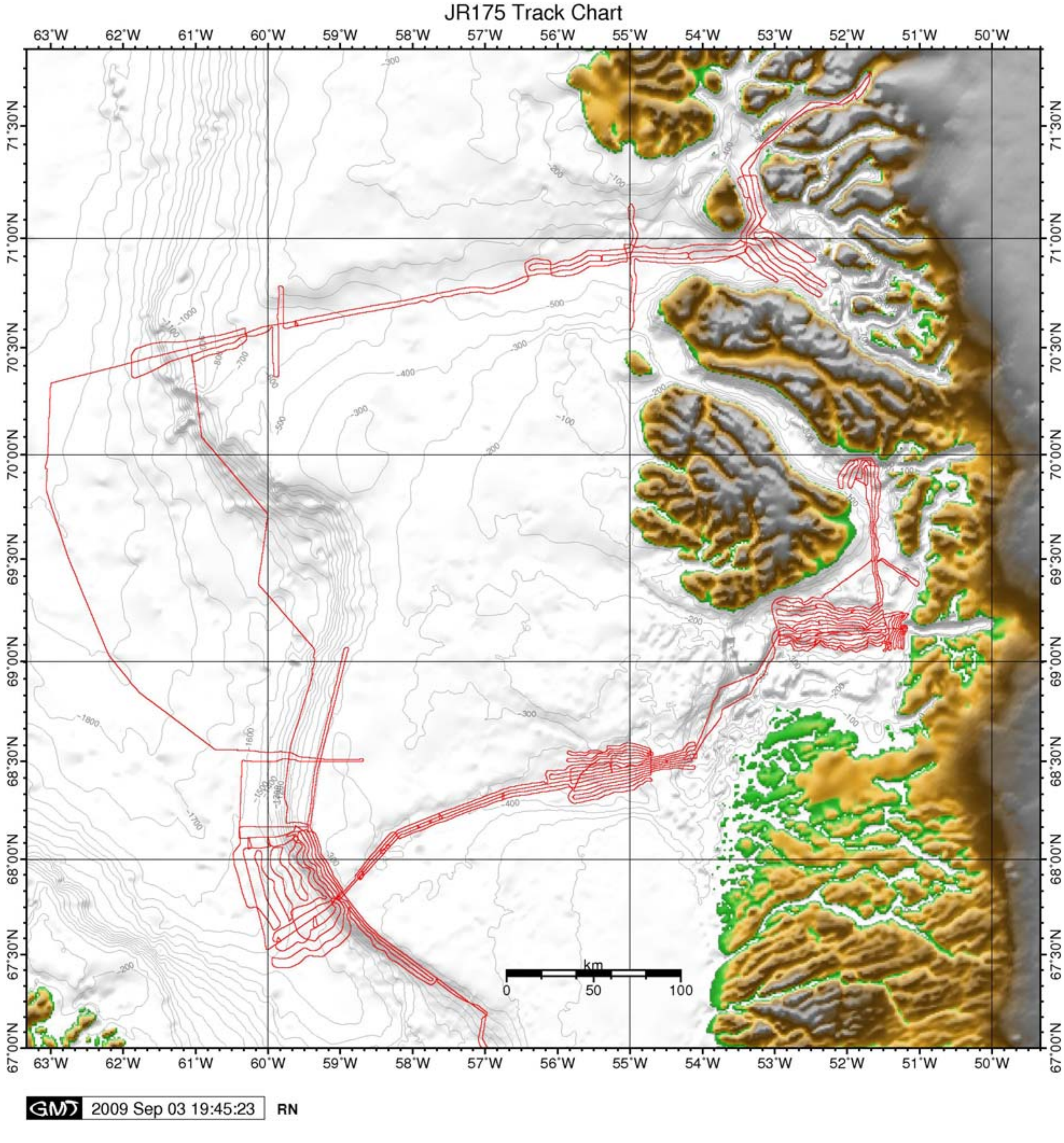

Figure 1. JR175 Ship track

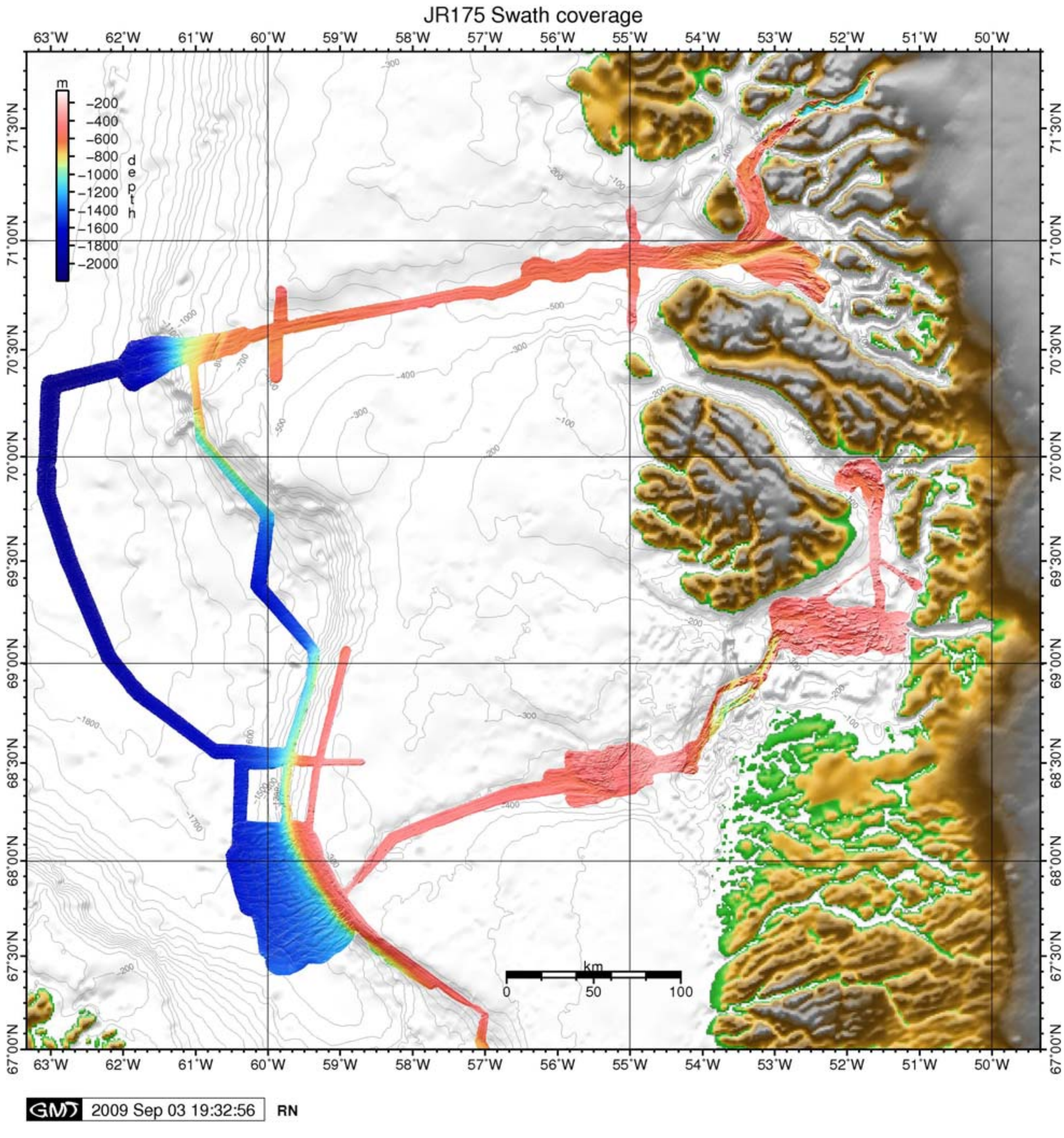

Figure 2. JR175 EM120 multibeam swath bathymetry coverage

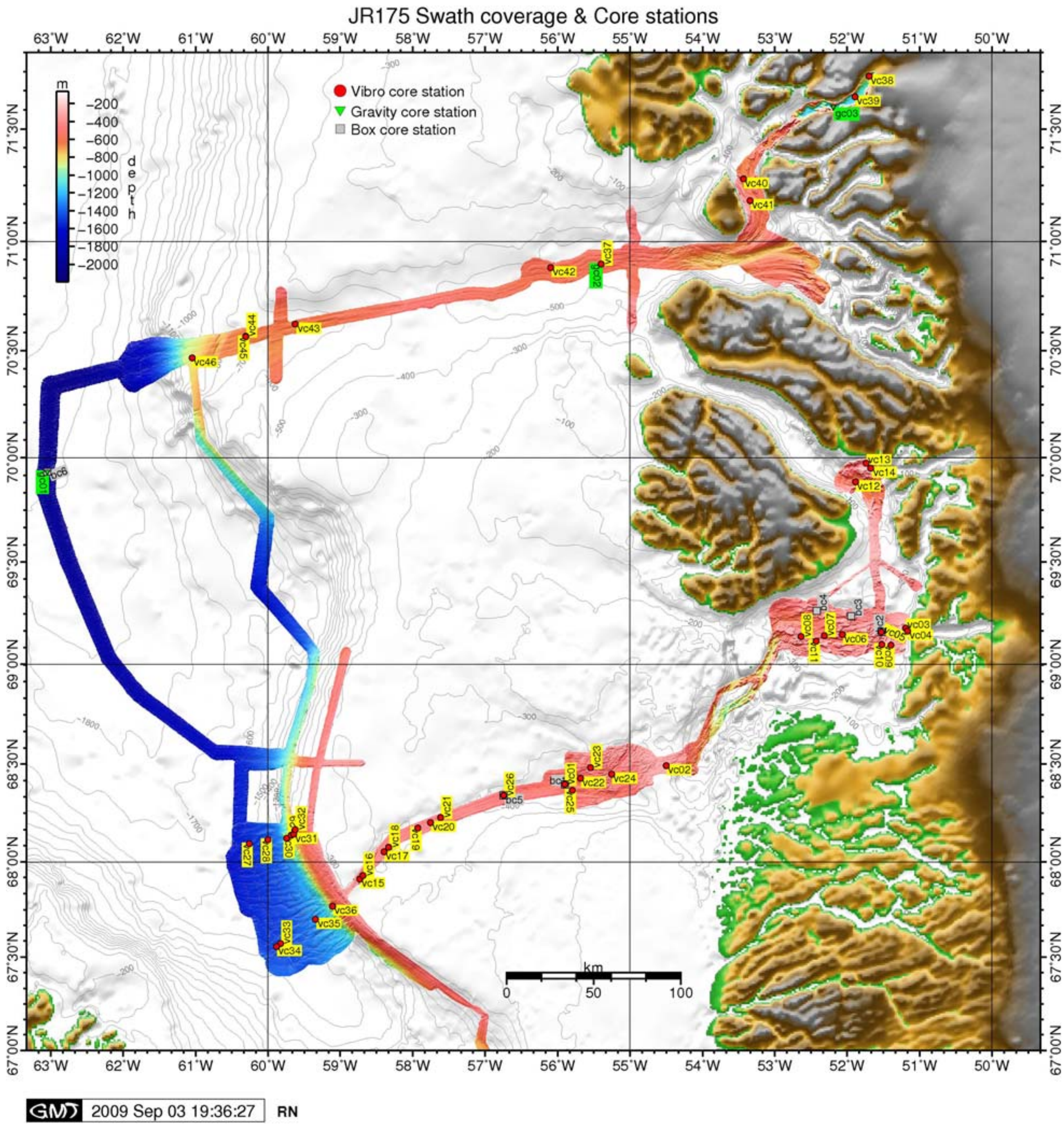

Figure 3. JR175 swath coverage and core stations

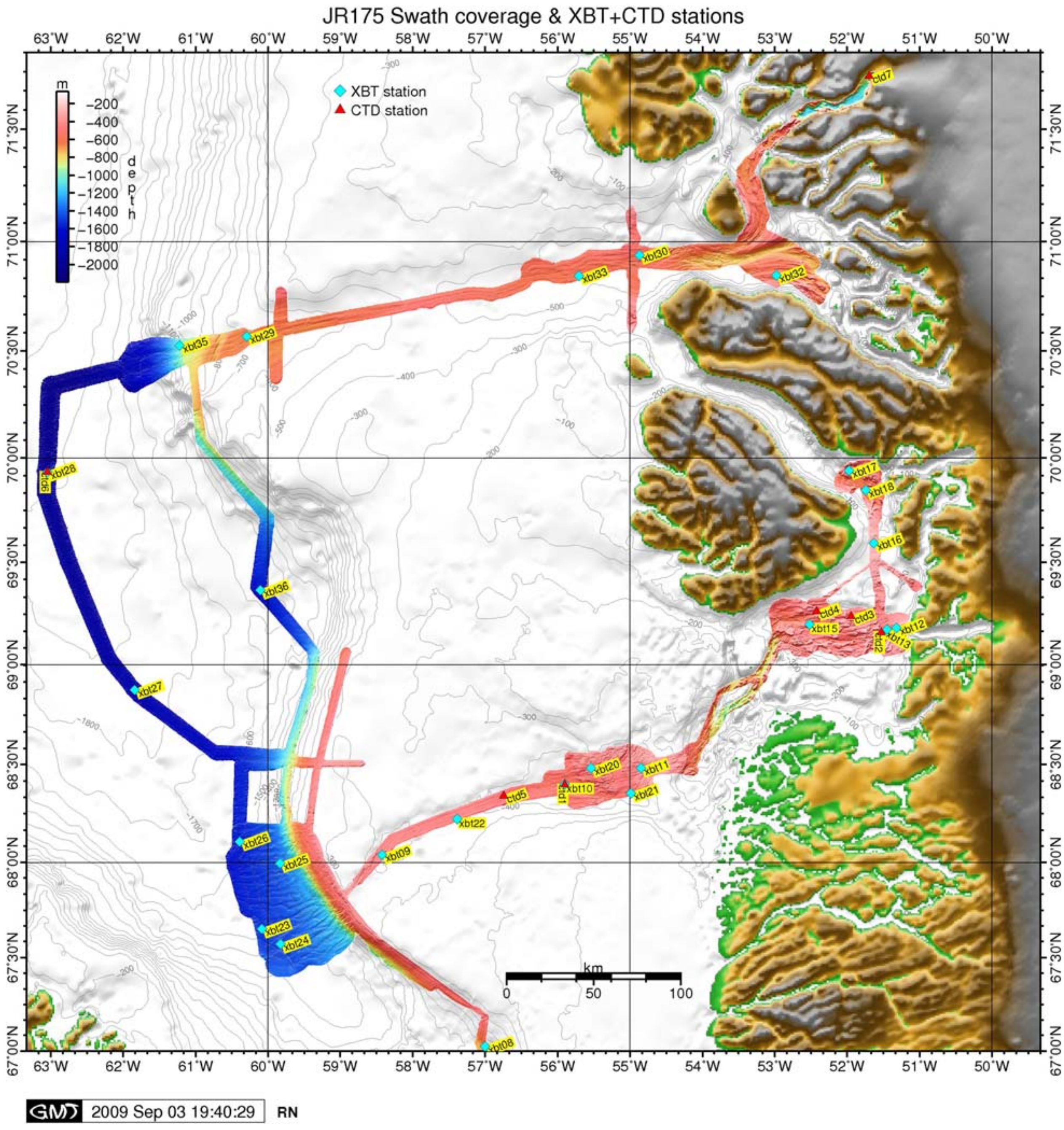

Figure 4. JR175 swath coverage with XBT and CTD stations.

1.3 Cruise Participants

Officers and Crew
Jerry Burgan, Master
David Hutchonson, Chief Officer
Simon Evans, 2nd Officer
Alex Spooner, 3rd Officer
John Summers, Deck Officer
Michael Gloisten, ETO (Comms)
Duncan Anderson, Chief Engineer
Thomas Elliott, 2nd Engineer
James Stevenson, 3rd Engineer
Ralph Tulloch, 4th Engineer
Doug Trevett, Deck Engineer
John McManmon, ETO (ENG)
Richard Turner, Purser
David Peck, Bosun
Albert Bowen, Bosun's Mate
Kelvin Chappell, SG1
Ian Raper, SG1
George Dale, SGI
Anthony Estibeiro, SG1
David Triggs, SG1
Robert Hart, MG1
Gareth Wale, MG1
Ashley Huntley, Chief Cook
Jamie Lee, 2nd Cook
Lee Jones, Senior Steward
Nicholas Greenwood, Steward
Graham Raworth, Steward
Michael Weirs, Steward

Scientific party
Colm Ó Cofaigh (Department of Geography, Durham University)(Chief Scientist)
Aoibheann Kilfeather (Department of Geography, Durham University)
Stephen Livingstone (Department of Geography, Durham University)
Julian Dowdeswell (Scott Polar Research Institute, University of Cambridge)
Jeff Evans (Department of Geography, University of Loughborough)
Riko Noormets (University Centre in Svalbard, Norway)
Anne Jennings (Institute of Arctic and Alpine Research, University of Colorado, USA)
Mariah Walton (Institute of Arctic and Alpine Research, University of Colorado, USA)
Quentin Simon (GEOTOP, Université du Quebec à Montréal, Canada)
Jean McNeil (University of East Anglia)
Neil Campbell (Vibrocore team, British Geological Survey)
Michel Wilson (Vibrocore team, British Geological Survey)
Mary Mowat (Vibrocore team, British Geological Survey)
Keith Gibson (Vibrocore team, British Geological Survey)
Johnny Edmonston (BAS ITS)
Julian Klepacki (BAS AME)
Jim Fox (BAS AME)

Neris Lewis (Doctor, BASMU)

1.4 Cruise Narrative

Tuesday August 4. Scientific party for JR175 boarded the ship by pilot boat transfer from Falmouth. Ship underway by 10.30 LT. Induction talk for scientific party followed by safety drill and boat drill.

Wednesday August 5. Sailing across Celtic Sea Shelf. Noon position: 50˚ 50.9’ N, 011˚ 010.0’ W. Force 6. Sea state - rough.

Thursday August 6. Passage over Porcupine Bank and towards Rockall Trough. Ship’s clocks retarded by 1 hr to GMT. Noon position: 52˚ 40.8’ N, 018˚ 014.9’ W. Force 5 and moderate sea state.

Friday August 7. Sailing westwards over mid-Atlantic Ridge (clearly visible on EM120 swath bathymetry and TOPAS). Talk on science background and cruise objectives to ship’s company and scientific party. Ship’s clocks retarded by 1 hr to GMT. Noon position: 54˚ 36.3’ N, 026˚ 010.0’ W. Force 3 and moderate sea state.

Saturday August 8. Continued passage towards Kap Farvel across Reykjanes Ridge and southern end of the Irminger Basin. Noon position: 56˚ 36.7’ N, 034˚ 18.1’ W. Force 2 and slight sea state.

Sunday August 9. Passed Kap Farvel and commenced passage along west Greenland shelf edge/upper slope towards study area. Greenland became visible to the east at about 22.00Z and passed large iceberg about 21.30 hr. Noon position: 58˚ 44.6’ N, 042˚ 26.4’ W. Force 3 and sea state ‘slight’.

Monday August 10. Sailing north along the SW Greenland shelf edge/upper slope, passing Julianshaab and Frederikshab. Clear views of mountains to east and pod of whales sited at 21.30Z off the starboard side. Swath shows well developed sets of gullies incised into the shelf edge and upper slope for considerable distances along the margin. Wet test of vibrocorer carried out at 08.00 hr LT. Fire drill for scientific party at 10.30 hr LT. Noon position: 61˚ 15.2’ N, 050˚ 05.1’ W. Force 3 and sea state ‘slight’.

Tuesday August 11. Continued passage north along the west Greenland margin. Excellent examples of gully systems on shelf edge/upper slope imaged by the EM120. Increasing nos. of icebergs visible. JR175 Survey 1 started at 23.40 hr LT running swath lines along shelf edge and upper part of Disko Trough Mouth Fan. Atlantic Explorer and 2 other ships visible between 23.00-00.00 hr LT. Noon position: 65˚05.0’ N, 055˚ 07.9’ W. Sea state - slight. Force 1.

Wednesday August 12. Running swath along shelf edge/upper slope, followed by line into deeper water which imaged gullies at 800-900 m depth. Noon position: 68˚49.0’ N, 059˚ 03.8’ W. Sea state - slight. Force 2.

Thursday August 13. Running swath lines along mid-outer shelf trough. Two vibrocores, one boxcore and CTD collected from mid-shelf. Ship conducted ‘Man Overboard’ exercise and lifeboats launched and run. Noon position: 67˚40.6’ N, 058˚ 44.5’ W. Sea state - slight. Force 3.

Friday August 13. Continued swath lines on mid-shelf. First two vibrocores (VC01 and VC02) collected in addition to CTD01 and a boxcore (BC01) on the inner-mid shelf. Passed through islands at entrance to Disko Bay and commenced swath survey running lines east to ~51˚30 offshore of Jakobshavns Isfjord. Noon position: 68˚26.6' N, 055˚ 52.4' W. Sea state - slight. Force 1.

Saturday August 15. Running swath lines in Disko Bay. Boat transfer of personnel to and from ship at 12.00 hr LT. Vessel underway again and surveying by 15.16 hr LT, running swath lines southwards through spectacular iceberg infested waters offshore of the front of Jakobshavns Isfjord. Commenced coring transect with two vibrocores from innermost shelf amongst icebergs (VC03 and VC04). Noon position: 69˚13.9' N, 051˚ 08.9' W. Sea state - slight. Force 1.

Sunday August 16. Completed core transect (4 further vibrocores VC05-VC08, boxcore and CTD) and re-commenced north-south lines offshore of Jakobshavns Isfjord followed by a series of east-west lines into outer Disko Bay. Noon position: 69˚14.7' N, 051˚ 14.5' W. Sea state - slight. Force 2.

Monday August 17.
Continued swath survey of Disko Bay. Three vibrocores (VC09-VC11) collected from central Disko Bay. Noon position: 69˚12.9' N, 052˚ 30.7' W. Sea state - slight. Force 1.

Tuesday August 18. Two CTDs and boxcores collected Tuesday am from outer Disko Bay. Commenced survey of Vaigat running north-south lines. Innuit settlement of Sarqaq on north side of Vaigat clearly visible. Noon position: 69˚55.7' N, 051˚ 50.6' W. Sea state - slight. Force 3.

Wednesday August 19. Collected three vibrocores from the Vaigat overnight (VC12-VC14) and completed Vaigat swath survey. Proceeded westwards out of Disko Bay through islands and onto mid-shelf. Noon position: 68˚22.0' N, 056˚ 06.9' W. Sea state - moderate. Force 4.

Thursday August 20. Swath survey westwards to outer shelf. Ran back east and started transect of 7 vibrocores overnight on outer shelf collecting VC15 and VC16). Noon position: 68˚27.2' N, 056˚ 05.6' W. Sea state - moderate. Force 3.

Friday August 21. Completed vibrocore transect on outer shelf and swath east to mid-shelf collecting the remaining 5 cores Friday am (VC17-VC21). Swath west and continue a swath survey of 'moraine' system on mid-shelf. At 23.28 hr LT commenced collection of the first (VC22) of three vibrocores from mid-shelf 'moraine' on mid-shelf. Noon position: 68˚22.0' N, 056˚ 06.9' W. Sea state - moderate. Force 4.

Saturday August 22. Completed collection of vibrocores from mid-shelf 'moraine' overnight (VC23-VC24). Continued swath survey of mid-shelf running east-west swath lines. Noon position: 68˚32.6' N, 055˚ 51.8' W. Sea state - slight. Force 5.

Sunday August 23. Two vibrocores (VC25 and VC26) collected overnight (am). A box core and CTD were also collected at the site of VC26. Proceeded westwards swathing to shelf edge and crossed into Canadian territory. Proceeded with swath survey SW down the trough mouth fan into deep water. Commenced first of a transect of 6 vibrocores on the Disko Fan from 1600 m water depth starting with VC27. Noon position: 67˚57.1’ N, 058˚ 43.0’ W. Sea state - slight. Force 5.

Monday August 24. Completed first vibrocore transect on Disko Fan (am) – VC28-VC32. Commenced swath survey running north-south lines along the slope. Commenced second transect (southern) of 4 vibrocores on the Disko Fan (pm) with recovery of VC33. Sea state - moderate. Force 5. Noon position: 67˚48.6’ N, 059˚ 01.8’ W.

Tuesday August 25. Completed second vibrocore transect on the Disko Fan with recovery of VC34 and VC35. A final site (VC36) was unsuccessful with zero recovery. Continued swath survey imaging impressive channel/levee systems on swath and TOPAS. Noon position: 67˚44.3’ N, 059˚ 38.8’ W. Sea state - rough. Force 7.

Wednesday August 26. Completed swath block on trough mouth fan overnight Tuesday/Wednesday and commenced transit to the Umanaq Fan via the deep sea. Noon position: 68˚30’ N, 059˚ 57.7’ W. Sea state - moderate. Force 5.

Thursday August 27. Transit to Umanak Fan. Gravity core (GC01), box core (BC06) and CTD (CTD06) in 2000 m water depth in abyssal plain sediments offshore of Umanak Fan. Swath line up the fan imaging debris flows on TOPAS and onto the shelf. Moraines and intervening stratified sediment basins imaged on TOPAS on outermost shelf. Noon position: 70˚02.3’ N, 063˚ 02.3’ W. Sea state - moderate. Force 4.

Friday August 28. Running east-west swath lines on inner-mid shelf. Well developed streamlined subglacial bedforms recording ice flow across the shelf imaged by swath and thick sediment packages on inner shelf by TOPAS. Attempted vibrocore on inner shelf but unsuccessful due to circuit failure. Gravity core GC02 recovered instead. Noon position: 70˚53.9’ N, 055˚ 24.0’ W. Sea state - Slight. Force 1.

Saturday August 29. Running swath line into Umanak Fjord and northwards through Igdlorssuit Sund, Karrats Isfjord (Figure 5) and Kangigdleq in calm seas and stable weather. CTD (CTD07) and vibrocore (VC38) collected offshore of Rinks Glacier and a further vibrocore (VC39) and gravity core (GC03)(due to system failure of the vibrocorer) in mid-outer Kangigdleq. Return to Umanak Fjord and commenced swath survey block. Noon position: 71˚36.5’ N, 052˚ 03.9’ W. Sea state - moderate. Force 5.

Sunday August 30. Broke off from survey of Umanak Fjord to collect two viborcores (VC40 and VC41) from Igdlorssuit Sund. Recommenced swath survey of Umanak Fjord and imaged spectacular streamlined glacial bedforms recording convergent ice flow onto the inner shelf. Noon position: 71˚15.1’ N, 059˚ 53 14.2’ W. Sea state - slight. Force 3.

Monday August 31. Running east-west swath line across shelf followed by north-south lines on outer shelf. Streamlined subglacial bedfroms imaged on the swath recording shelf edge directed ice flow. One vibrocore collected from the mid-shelf (VC42) and a further core collected from the outer shelf (VC43). Noon position: 70˚54.5’ N, 056˚ 19.6’ W. Sea state - slight. Force 3


Figure 5. Tributary glaciers, Karrats Isfjord

Tuesday September 1.
Running swath lines on the outer shelf and Umanak trough mouth fan. Two vibrocores collected. VC44 was from the crest of a moraine on the outermost shelf but only recovered a bag sample. A second attempt proved more successful recovering 1.41 m (VC45). A further core (VC46) was collected from 850 m water depth in debris flows on the upper slope. Noon position: 70˚34N, 060˚ 18.4’ W. Sea state - slight. Force.

Wednesday September 2. Swath south overnight from Umanak Fan to the Disko Fan. A final vibrocore taken on the upper part slope of the Disko Fan in hard rocky ground (VC36). This was a repeat of the attempt to core this site on August 25 at which nil recovery was recorded. On this occasion a core of 0.57 m was recovered. This was then followed by completion of a series of east-west swath lines from the shelf edge to lower fan. Noon position: 67˚46.1’ N, 059˚ 06.6’ W. Sea state - slight. Force 4.

Thursday September 3. Completed east-west survey lines on Disko Fan and proceeded south to join up with existing northward transit line along west Greenland margin. Sailing south along west Greenland shelf and upper slope. Ship passed south of the Arctic Circle at 06.40 hr LT. Noon position: 65˚34.7’ N, 055˚ 46.9’ W. Sea state - slight. Force 4.

Friday September 4. Sailing south along west Greenland shelf and upper slope in rough seas. Noon position: 62˚24.7’ N, 051˚ 41.3’ W. Sea state - rough. Force 8.

Saturday September 5. Sailing south along west Greenland shelf and upper slope. Passed south of Cape Farvel at 19.02 hr LT. Noon position: 59˚40.6' N, 046˚ 22.5' W. Sea state - slight. Force 4.

Sunday September 6. On passage to Immingham. Noon position: 59˚08.4' N, 036˚ 50.0' W. Sea state - slight. Force 4.

Monday September 7. On passage to Immingham. Noon position: 59˚02.9' N, 026˚ 26.2' W. Sea state – rough. Force 3.

Tuesday September 8. On passage to Immingham. Crossed Hatton Bank and Rockall Basin in heavy seas. Noon position: 58˚24.8' N, 016˚ 52.2' W. Sea state – heavy. Force 7.

Wednesday September 9. On passage to Immingham. Passed Cape Wrath 16.00 hr LT and entered the Pentland Firth 20.00 hr LT. End of cruise dinner. Noon position: 58˚45.3' N, 7˚ 04.2' W. Sea state – rough. Force 6.

Thursday September 10. On passage to Immingham through the North Sea. Noon position: 56˚24.1' N, 0˚ 55.6' W. Sea state – slight. Force 3.

Friday September 11. Humber pilot at 08.00 hr LT and along side Immingham Dock at 11.00 hr LT.

End of Cruise JR175.

2. GEOPHYSICAL OPERATIONS

2.1 EM120 Multibeam Swath Bathymetry and TOPAS Sub-Bottom Profiler

The Kongsberg-Simrad EM120 multibeam swath bathymetry system was operated throughout the cruise. Limited post-processing of the EM120 data (gridding and data filtering) was carried out using the Kongsberg-Simrad NEPTUNE post-processing software. The data coverage is shown in Figures 1 and 2 (ship track and TOPAS profiles are red lines in Figure 1 and swath data are shown in Figure 2). The swath and TOPAS data were each recorded digitally throughout the cruise, but TOPAS data was also played out in near-real time on an EPC chart recorder (see below).

2.2 EPC Chart Recorder

The EPC chart recorder worked without any problems throughout the cruise. TOPAS input to the EPC chart recorder was on Channel A. The settings used were: 0.5 second sweep; 0 delay; threshold 1/3 of a turn clockwise from the minimum setting; trigger level 0; gain generally about 2-3; sweep direction from left to right; print polarity +/- (centre setting). Chart settings: scale lines: on; take-up: on; mark/annotate: off (centre setting); chart drive: internal centre setting), LPI was generally set to 75; contrast setting: centre. Ten-minute time marks and EM120 depths were automatically plotted on the paper roll.

3. GEOLOGICAL OPERATIONS

Vibro-, gravity and box cores were taken from JCR in fjord-shelf-slope-deep sea settings of the central west Greenland margin (Figure 3). Details of each core site are given in Tables 1 and 2 below. Both the vibro- and gravity corers were operated with a 6 m barrel throughout the cruise. In general recovery was good depending on the nature of the substrate. The box corer was typically subsampled using a series of 3-4 pushcores.

Figure 6. Deployment of the vibrocorer from the aft deck, outer Disko shelf. August 20, 2009

Table 1. Vibrocores (“VC-”) and Gravity cores (“GC-“) collected during cruise JR175						
Core	*Date of collection*	*Grid Reference*	*Location*	*Water depth (m)*	*Recovery (m)*	*Comments*
VC01	13/08/09 JD225	68˚23.9’N 055˚53.9W	Disko mid-shelf	545m	2.70 m (3 sections)	BC01 and CTD01 collected from same site
VC02	14/08/09 JD 226	68º 29.59’N 054º 29.97W	Disko mid-shelf	291m	0.85 m (1 section)	
VC03	15/08/09 JD227	69º 10.81’N 051º 11.61’W	Disko Bugt – in front of ice fjord	248 m	1.57 m (2 sections)	
VC04	15/08/09 JD227	69º 9.97’N 051º 10.15’W	Disko Bugt – in front of ice fjord	263 m	1.10 m (2 sections)	
VC05	16/08/09 JD228	69º 9.6’N 051º 31.63’W	Disko Bugt.	389 m	5.87 m (6 sections)	Easternmost core of a 4 vibrocore transect (north) westwards from the ice fjord (VC05-VC08). BC02 and CTD02 collected from same site as VC05.
VC06	16/08/09 JD228	69º 8.94’N 052º 04.14’W	Disko Bugt	439 m	4.94 m (5 sections)	
VC07	16/08/09 JD228	69º 08.62’N 052º 18.88’W	Disko Bugt	439 m	5.46 m (6 sections)	
VC08	16/08/09 JD228	69º 08.35’N 052º 38.24’W	Disko Bugt	429 m	3.91 m (4 sections)	
VC09	17/08/09 JD229	69º 05.79’N 051º 23.65’W	Disko Bugt	294 m	5.98 m (6 sections)	Easternmost core of a 3 vibrocore transect (south) westwards from the ice fjord (VC09-VC11).
VC10	17/08/09 JD229	69º 05.95’N 051º 31.22’W	Disko Bugt	351 m	4.86 (5 sections)	
VC11	17/08/09 JD229	69º 06.90’N 052º 25.60’W	Disko Bugt	410 m	3.25 m (4 sections)	
VC12	19/08/09 JD231	69º 53.12’N 051º 53.15’W	Vaigat	616 m	3.66 m (4 sections)	
VC13	19/08/09 JD231	69º 58.46’N 051º 44.47’W	Vaigat	341 m	3.4 m (4 sections)	
VC14	19/08/09 JD231	69º 56.97’N 051º 40.35’W	Vaigat	386 m	4.66 m (4 sections)	
VC15	20/08/09 JD232	67º 54.53’N 058º 43.91’W	Outermost Disko shelf in front of ‘moraine’	347 m	0.55 m (1 section)	Westernmost core of shelf transect east from shelf edge to mid-shelf (VC15-VC21)
VC16	20/08/09 JD232	67º 55.67’N 058º 41.28’W	Outermost Disko shelf on top of ‘moraine’	358 m	0.77 m (1 section)	
VC17	21/08/09	68º 03.04’N	Outer Disko shelf	399 m	0.82 m (1 section)	

	JD233	058º 23.72'W				
VC18	21/08/09 JD233	68º 04.51'N 058º 20.18'W	Outer Disko shelf	400 m	0.56 m (1 section)	
VC19	21/08/09 JD233	68º 10.47'N 057º 55.70'W	Outer Disko shelf	415 m	2.04 m (3 sections)	
VC20	21/08/09 JD233	68º 12.06'N 057º 45.38'W	Outer Disko shelf	424 m	5.39 m (6 sections)	
VC21	21/08/09 JD233	68º 13.65'N 057º 37.03'W	Outer Disko shelf	430 m	5.10 m (6 sections)	Hudson 070 core location
VC22	21/08/09 JD233	68º 25.76'N 055º 41.23'W	Disko mid-shelf	457 m	4.83 m (5 sections)	
VC23	22/08/09 JD234	68º 28.98'N 055º 32.60'W	Disko mid-shelf	400 m	5.96 m (6 sections)	
VC24	22/08/09 JD234	68º 26.88'N 055º 15.16'W	Disko mid-shelf	432 m	5.63 m (6 sections)	
VC25	23/08/09 JD235	68º 22.01'N 055º 47.78'W	Disko mid-shelf	521 m	4.93 m (5 sections)	
VC26	23/08/09 JD235	68º 20.49'N 056º 44.64'W	Disko mid-shelf	446 m	4.65 m (5 sections)	BC05 and CTD05 collected from same site
VC27	23/08/09 JD235	68º 06.55'N 060º 15.69'W	Disko Fan.	1547 m	6 m (6 sections)	Lower slope Disko fan. Stratified sediments. Transect of 6 cores VC27-VC32) from lower to upper fan.
VC28	24/08/09 JD236	68º 06.76'N 059º 59.83'W	Disko Fan.	1414 m	6 m (6 sections)	Lower slope Disko fan. Stratified sediments.
VC29	24/08/09 JD236	68º 07.35'N 059º 44.36'W	Disko Fan.	1064 m	5.80 m (6 sections)	Disko fan. Gully floor.
VC30	24/08/09 JD236	68º 08.30'N 059º 40.74'W	Disko Fan.	825 m	1.85 m (2 sections)	Upper Disko fan. Debris flows.
VC31	24/08/09 JD236	68º 08.50'N 059º 38.62'W	Disko Fan.	745 m	0.23 m (bagged)	Upper Disko fan. Debris flows.
VC32	24/08/09 JD236	68º 09.96'N 059º 37.43'W	Disko Fan.	690 m	2.34 m (3 sections)	Upper Disko fan. Debris flows.
VC33	24/08/09 JD236	67º 34.29'N 059º 49.46'W	Disko Fan.	1455 m	3.88 m (4 sections)	Lower Disko fan. Levee; acoustically stratified sediment. Transect of 4 cores VC33-VC36) from lower to upper fan.
VC34	25/08/09 JD237	67º 33.36'N 059º 53.03'W	Disko Fan.	1476 m	3.45 m (4 sections)	Lower Disko fan. Channel floor.
VC35	25/08/09 JD237	67º 42.03'N 059º 20.54'W	Disko Fan.	1267 m	5.36 m (6 sections)	Disko fan. Levee; acoustically stratified sediment.
VC36	25/08/09 JD237	67º 46.08'N 059º 06.59'W	Disko Fan.	767 m	0.57 m (1 section)	Upper Disko fan. Debris flow.
GC01	27/08/09 JD239	69º 56.01N 063º 03.4W	Baffin Bay	2034 m	2.75 m (3 sections)	Abyssal plain. BC06 and CTD06 also collected from this site.
VC37	28/08/09	70º 53.87'N	Umanak shelf	543 m	Shoe sample (Bag)	

	JD240	055º 23.98'W	(mid)			
GC02	28/08/09 JD240	70º 53.81'N 055º 23.89'W	Umanak shelf (mid)	544 m	3.53 m (4 sections)	
VC38	29/08/09 JD241	71º 43.82'N 051º 41.64'W	Kangigdleg Fjord	625 m	Bag	Rinks Glacier ice front. CTD07 collected from same site.
VC39	29/08/09 JD241	71º 38.46'N 051º 53.64'W	Kangigdleg Fjord	1109 m	5.45 m (6 sections)	15 km downfjord from Rinks Glacier ice front
GC03	29/08/09 JD241	71º 35.85'N 052º 11.39'W	Kangigdleg Fjord	1125 m	4.41 m (5 sections)	25 km downfjord from Rinks Glacier ice front
VC40	30/08/09 JD242	71º 16.73'N 053º 26.08'W	Igdlorssuit Sund	663 m	4.06 m (5 sections)	
VC41	30/08/09 JD242	71º 11.01'N 053º 20.63'W	Igdlorssuit Sund	518 m	4.83 m (5 sections)	
VC42	31/08/09 JD243	70º 52.93'N 056º 05.55'W	Umanak shelf (mid)	554 m	5.50 m (6 sections)	
VC43	31/08/09 JD243	70º 37.37'N 059º 37.25'W	Umanak shelf (outer)	629 m	3.15 m (4 sections)	
VC44	01/09/09 JD244	70º 34.02'N 060º 18.31'W	Umanak shelf (outermost)	647 m	Bag	Crest of moraine on outermost shelf
VC45	01/09/09 JD244	70º 33.99'N 060º 18.45'W	Umanak shelf (outermost)	648 m	1.41 m (2 sections)	Crest of moraine on outermost shelf. Repeat of VC44.
VC46	01/09/09 JD244	70º 28.13'N 061º 02.91'W	Umanak fan	845 m	5.58 (6 sections)	Trough mouth fan upper slope. Debris flows.

Table 2. Boxcores ("BC-") collected during cruise JR175

Core	*Date of collection*	*Grid Reference*	*Location*	*Water depth (m)*	*Recovery (m)*	*Comments*
BC01	13/08/09 (JD225)	68˚23.9'N 055˚53.9W	Disko mid-shelf	545m	0.36	VC01 and CTD01 collected from same site
BC02	16/08/09 JD228	69º 09.6'N 051º 31.63'W	Disko Bugt.	389 m	0.4 m	VC05 and CTD02 collected from same site.
BC03	18/08/09 (JD230)	69º 13.44'N 051º 56.56'W	Disko Bugt.	400 m	0.4 m	CTD03 collected from same site
BC04	18/08/09 (JD230)	69º 15.85'N 052º 25.09'W	Disko Bugt.	490 m	0.4 m	CTD04 collected from same site
BC05	23/08/09 JD235	68º 20.49'N 056º 44.64'W	Disko mid-shelf	446 m	0.37 m	VC26 and CTD05 collected from same site
BC06	27/08/09 JD239	69º 56.01N 063º 03.4W	Baffin Bay	2034 m	0.49 m	Abyssal plain. GC01 and CTD06 also collected from this site.

4. OCEANOGRAPHIC OPERATIONS

4.1 Expendable Bathythermograph (XBT) System and Ocean Logger

Several XBT casts were made during JR175 (see Table 3 and Figure 4). Sound velocity profiles (SVP) obtained from the XBT deployments were input to the EM120 and used in the relevant surveys. Individual SVP profiles were calculated from the XBT data by the system software, assuming a constant salinity. Salinity values were obtained from the Oceanlogger display (located in the UIC), and input to the XBT system software manually. The files (calculated sound velocity profiles) generated by the XBT system software were transferred to the swath bathymetry data processing workstation, and the data then imported into the swath data acquisition system across the network. Surface water temperature and salinity were also recorded continuously during the cruise.

Table 3. List of XBTs collected during cruise JR175

XBT #	*Julian Day*	*Time of Launch*	*Lat N*	*Long W*	*Depth (m)*	*File name*		*Notes*
1	219		54º 39.94’	26º 16.49’	1800+	jr175_219_xbt01.asvp	T5_00001.rdf	
2	221	21:16	59º 30.54’	45º 28.5’	319	jr175_221_xbt02.asvp	T7_00002.rdf	
3	223	10:08	64º 24.71’	54º 24.696’	231	jr175_223_xbt03.asup	T7_00003.rdf	
4	223	10:50	64º 31.06’	54º 32.54’	267	jr175_223_xbt04.asup	T7_00004.rdf	
5	223	13:50	65º 4.55’	55º 9.68’	700	jr175_223_xbt05.asup	T7_00005.rdf	
6	223	13:55	65º 4.55’	55º 9.68’	711	jr175_223_xbt06.asup	T5_00006.rdf	
7	223	15:26	65º 18.16’	55º 24.61’	712	jr175_223_xbt07.asup	T5_00007.rdf	
8	224	0:55	67º 2.9’	57º 1.9’	708	jr175_224_xbt08.asup		
9	224	17:52	68º 42.79’	49º 10.74’	474	jr175_224_xbt09.asup	T7_00009.rdf	
10	225	17:20	68º 1.9’	58º 26.2’	404	jr175_225_xbt10.asup	T7_00010.rdf	
11	226	10:30	68º 28.94’	54º 50.99’	339	jr175_226_xbt11.asup	T7_00011.rdf	
12	227	19:12	69º 11.026’	51º 19.063’	330	jr175_227_xbt12.asup	T7_00012.rdf	
								No XBT 13
14	228	13:05	69º 10.51’	51º 26.93’	390	jr175_228_xbt14.asup	T7_00014.rdf	
15	229	11:51	69º 11.99’	52º 31.27’	321	jr175_229_xbt15.asup	T7_00015.rdf	
16	230	11:07	69º 35.55’	51º 38.01’	253	jr175_230_xbt16.asup	T7_00016.rdf	
17	230	15:51	69º 56.44’	51º 58.40’	475	jr175_230_xbt17.asup	T7_00018.rdf	T7_00018.rdf, 00017 was not created when launched due to sequencing issues
18	230	23:26	69º 50.87’	51º 44.61’	621	jr175_230_xbt18.asup	T7_00019.rdf	
19	232	12:42	68º 28.959’	55º 32.363’	403	jr175_232_xbt19.asup	T7_00020.rdf	
								no 20 - sequencing error
21	234	23:30	68º 21.17’	55º 0.26’	495	jr175_234_xbt21.asup	T7_00021.rdf	
22	235	10:13	68º 13.41’	57º 23.01’	407	jr175_235_xbt22.asup	T7_00022.rdf	
23	235	17:57	67º 39.076’	60º 5.074’	1607	jr175_235_xbt23.asup	T5_00023.rdf	
24	237	00:17	67º 34.331’	59º 49.54’	1465	jr175_237_xbt24.asup	T5_00024.rdf	

25	237	21:52	67º 59.56’	59º 49.87’	1376	jr175_237_xbt25.asup	T5_00025.rdf	
26	238	10:40	68º 06.408’	60º 23.246’	1570	jr175_238_xbt26.asup	T5_00026.rdf	
27	239	00:41	68º 52.52’	61º 50.62’	1848	jr175_239_xbt27.asup	T5_00027.rdf	
28	239	10:55	69º 56.01’	63º 3.04’	2018	jr175_239_xbt28.asup	T5_00028.rdf	
29	239	21:31	70º 34.12’	60º 17.72’	647	jr175_239_xbt29.asup	T5_00029.rdf	
30	240	11:34	70º 56.27’	54º .22’	515	jr175_240_xbt30.asup	T7_00029.rdf	transferred to EM120 as T7_00029.rdf due to probe being loaded before operator ready no 31 - sequencing error
32	242	23:04	70º 50.78’	52º 58.79’	538	jr175_243_xbt32.asup	T7_00032.rdf	
33	243	11:17	70º 50.61’’	55º 42.26’	578	jr175_243_xbt33.asup	T7_00033.rdf	

4.2 CTD

The CTD system on the James Clark Ross comprises a Sea-Bird 911*plus* CTD system. This consists of an underwater unit with built in pressure sensor to which a suite of modular sensors can be connected and a SBE11*plus* Deck Unit. The deck unit facilitates the supply of power to the underwater unit via a conducting sea-cable and to decode the serial data returned from the underwater unit on the same sea-cable and passes it to a computer for graphical display and logging to disk. Figure 7 illustrates the CTD system and Figure 4 and Table 4 show the CTD stations occupied during JR175.

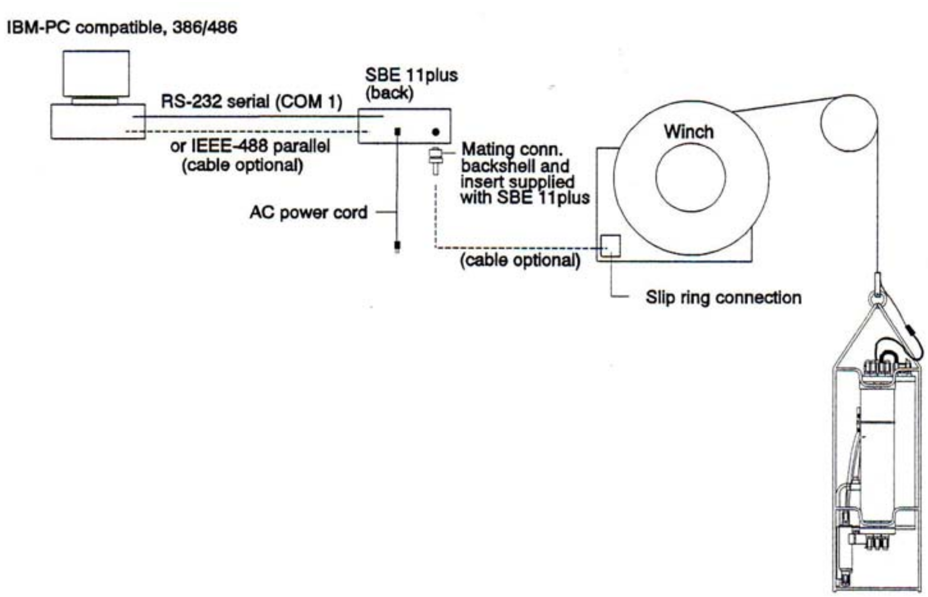

Figure 7. Sea-Bird 911plus CTD system.

Sea-Bird’s standard modular temperature (T) and conductivity (C) sensors (SBE 3*plus* and SBE 4*plus*) are mounted to the underwater unit within the guard cage. Two pairs of sensors are used to provide *primary* and *secondary* TC data sets for error comparison and redundancy. A pump is used to provide optimum and constant speed flushing of the paired temperature and conductivity sensors via a TC duct. Highest possible pressure accuracy is obtained by using the Paroscientific Digiquartz® pressure sensor. The 911*plus* system CTD produces profiles of ocean temperature, salinity and density at the highest possible absolute accuracy. To obtain this accuracy the system incorporates the following key features:

- A temperature sensor that is both accurate and fast;
- A conductivity sensor with a totally internal field that is immune to proximity effects;
- Constant (pumped) flow providing constant time responses in T and C;
- A "TC Duct" to ensure that the temperature and conductivity sensors measure the same water;
- A dramatically superior quartz pressure sensor;
- Modular sensors that can be calibrated separately;
- Acquisition electronics free of significant error

Table 4. List of CTD stations, JR175

CTD number	*Date of collection*	*Grid Reference*	*Location*	*Water depth (m)*	*Comments*
CTD01	13/08/09 (JD225)	68˚23.9'N 055˚53.9W	Disko mid-shelf	545m	VC01 and BC01 collected from same site
CTD02	16/08/09 JD228	69º 09.6'N 051º 31.63'W	Disko Bugt.	389 m	VC05 and BC02 collected from same site.
CTD03	18/08/09 (JD230)	69º 13.44'N 051º 56.56'W	Disko Bugt.	400 m	BC03 collected from same site
CTD04	18/08/09 (JD230)	69º 15.85'N 052º 25.09'W	Disko Bugt.	490 m	BC04 collected from same site
CTD05	23/08/09 JD235	68º 20.49'N 056º 44.64'W	Disko mid-shelf	446 m	VC26 and BC05 collected from same site
CTD06	27/08/09 JD239	69º 56.01N 063º 03.4W	Baffin Bay	2034 m	Abyssal plain. GC01 and BC06 also collected from this site.
CTD07	29/08/09 JD241	71º 43.82'N 051º 41.64'W	Kangigdleg Fjord	625 m	Rinks Glacier ice front. VC38 collected from same site.

Looking north up Karrats Isfjord. August 29, 2009.

5. APPENDICES

5.1 Sonar System Parameter Settings

EM120
MBES screen
Ping Mode: Auto
Sector Coverage
    Max Port Angle: 50-70
    Max Starboard Angle: 50-70
    Angular Coverage: Manual
    Beam Spacing: Equidistant
Pitch stabilisation: On
Yaw stabilisation: Off
Min depth: Used to constrain depth when bottom is lost
Max. depth: Used to constrain depth when bottom is lost

Sound Speed Profile
    Current Sound Profile: jr175_xbtXX.asvp

Sound Speed at Transducer:
    From: Profile
    Sensor Offset: 0.0 m/s
    Filter: 60s

Filtering
    Spike Filter Strength: Medium
    Aeration: Off
    Sector Tracking: On
    Slope: On
    Interference: Off
    Range Gate: Normal
Absorption Coefficient
    Absorption (dB/km): 1.00
Seabed Imaging
    TVG Crossover (deg) 6

TOPAS Acquisition Parameters
<u><1000 m water depth</u>

Parasource Menu
Level: 100%
Ping Interval: 0 ms (enables external SSU triggering) or 1100-2500 ms (manual triggering).
Pulseform: Burst
Period: 1 or 2

Secondary Frequency: 2800 Hz

Acquisition Menu
Ch_no: 0
Speed of Sound (m/s): 1500
Sample Rate: 20000 Hz
Trace Length (ms): 400
Gain: 12 – 36 dB
Filter: 1.00 kHz
Delay: Manual

Processing Menu
Channel no: 0
Filter: ON
    Low stop: 1200 Low pass: 4800
    High pass: 1700 High stop: 5200
Processing (deconvolution): OFF
Swell: ON
    Threshold: 60%
    # traces: 1
TVG: OFF or AUTO or Man (all used at different times)
    Slope: (30 – 60 dB slope)
    Start point: Manual or Tracking or External
Deverb: OFF
Stacking: OFF
AVC: OFF
Scale (%): 700 – 1000
Attribute: INST.AMP

LOG/Replay Menu
Medium: DISK
Rate (ms): 1000
Channel: 0
File size (Mb): 10

>1000 m water depth
Parasource Menu
Level: 90 – 100%
Ping Interval: 2000 – 5000 ms (Manual triggering over rides SSU triggering)
Pulseform: Chirp
    Chirp start frequency (Hz): 1500
    Chirp stop frequency (Hz): 5000
    Length (ms): 15
Period: 1 or 2
Secondary Frequency: 2800 Hz

Acquisition Menu
Ch_no: 0
Speed of Sound (m/s): 1500
Sample Rate: 20000 Hz
Trace Length (ms): 400
Gain: 20 – 32 dB
Filter: 1.00 kHz
Delay: Manual or External

Processing Menu
Channel no: 0
Filter: ON
    Low stop: 1200 Low pass: 4800
    High pass: 1700 High stop: 5200
Processing (deconvolution): DECONV
    Filter factor (ppm): 1
Swell: ON
    Threshold: 60%
    # traces: 1
TVG: OFF or AUTO or Man (all used at different times)
    Slope: (30 – 60 dB slope)
    Start point: Manual or Tracking or External
Deverb: OFF
Stacking: OFF
AVC: OFF
Scale (%): 1000 – 3000
Attribute: INST.AMP

LOG/Replay Menu
Medium: DISK
Rate (ms): 1000
Channel: 0
File size (Mb): 10

SSU – Sonar Sequencing Unit
Group: EM & EA, EK, TOPAS
Trigger: EM120 & EA600: ON (both systems)
EK60: OFF
TOPAS: ON
Time usage: EM120 & EA600: Calculated (both systems)
    EK60: OFF
    TOPAS: Calculated
Time add on: variable depending on depth

The bridge echosounder (EA600) was run on passive, external trigger, and listened out for the EM120 centre-beam return and used this to calculate depth below the ship.

5.2 Scientific Party – Email Addresses

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