RRS James Clark Ross

JR168 Cruise Report

Swath bathymetry
South Sandwich Islands

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Cruise Report

RRS James Clark Ross

Cruise JR168

April - May 2007

Northern South Sandwich Islands Geophysical Survey (swath bathymetry, magnetometer)

Falkland Islands – South Georgia – South Sandwich Islands – Montevideo

Alexander J. Tate and Philip T. Leat

BAS Archive Reference No. ES6/1/2007/1

May 2007

Copy no.

Front Cover Image - Zavodovski Island

Introduction and Objectives

Cruise JR168 was undertaken as part of the Geological Sciences Division (BAS) Long Term Monitoring and Survey (LTMS) programme of work in the Scotia Sea area. The main aim of the survey was to map the underwater portion of the northern sector of the South Sandwich arc using EM120 multi beam (swath) bathymetry, to provide a base map for further geological and multidisciplinary research. As the cruise was joined with a Biological Sciences LTMS cruise (JR167) in the South Georgia area, an additional aim was to collect swath data opportunistically in the South Georgia area as well. The northern sector of the South Sandwich arc was chosen because of its proximity to South Georgia, minimising transit time.

The South Sandwich arc is a tectonically simple intra-oceanic arc situated in the South Atlantic. It is a seismically and volcanically active arc, built on the small Sandwich Plate. The arc is forming in response to steeply inclined subduction of the South American plate beneath the Sandwich plate.

There are few previous detailed bathymetric studies of the South Sandwich area, and none in the northern sector of the arc. As planning tools, we used the Admiralty chart of the area and a predicted bathymetry map derived from satellite altimetry.

The northern sector of the South Sandwich arc consist of the entirely submarine Protector Shoal, which is shown as rising to a depth of 27 m by the Admiralty chart, and which erupted in 1962, forming a large raft of floating rhyolitic pumice that was distributed by ocean current around the Southern Ocean (Gass et al. 1963; Leat et al. 2007). Very little was known about the bathymetry and volcanic forms of this shoal.

Zavodovski Island consists of a scoriaceous volcanic cone rising to 550 m, with flanking lava flows. The cone shows persistent fumarolic activity from the vicinity of a crater on its western side. The Admiralty chart suggests extensive shallow features around the volcano.

Visokoi Island consists of a single stratovolcano rising to about 1000 m, with steeply inclined flanks and no record of volcanic activity. The Admiralty chart shows relatively shallow water extending to the east and south east of the volcano.

The Candlemas group of islands consists of two main islands, Candlemas and Vindication. The northern part of Candlemas consists of a young, fumarolically active volcanic cone with flanking dacitic lava flows. The southern part of Candlemas and Vindication islands consist of older, eroded basaltic lava flows rising to 550 m on Candlemas Island (Leat et al. 2003). The Admiralty chart shows relatively shallow water extending to the northeast.

Further descriptions of the subaerial parts of the volcanoes are provided by Holdgate and Baker (1979), Baker (1990), Tomblin (1979) and Pearce et al. (1995). The geophysical and tectonic setting of the arc was recently described by Larter et al. (2003).

Narrative

A cruise track is shown in Figure 1 and a detailed narrative can be found in Appendix A, which gives specific information about cruise events. Overall the weather and sea state were conducive for science especially given how late it was in the season. The exception was a few days near Candlemas and Visokoi Islands where strong to gale force winds and heavy seas forced the survey into northeast-southwest bearing lines often at very low speeds. However, the weather improved towards the end of the main survey period and was near flat calm on the final lines near Protector Shoal. Note that the following narrative also includes details about JR167, a biology cruise involving mooring work and western core box acoustics around South Georgia.

18th April 2007 (Julian Day 108)
Departed Stanley around midday and began passage to the South Sandwich Islands on a course designed to cover previously unsurveyed areas.

19th April 2007 (Julian Day 109)
After meeting with the Captain and Peter Enderlein (PSO on the joint biology cruise JR167) it was decided to do the mooring/acoustic work first before heading to the South Sandwich Islands.

20th April 2007 (Julian Day 110)
Continuing towards the South Georgia area. As the weather was not considered good enough for deployment of the deep mooring south west of South Georgia, we headed for the shallow mooring site to the north of Bird Island.

21st April 2007 (Julian Day 111)
Weather at the shallow mooring site meant that recovery was not possible so we continued to King Edward Point for a personnel transfer (Andy Chase) to Bird Island. A harbour boat was run out to the ship to avoid wasting time in tying up. We steamed back to Bird Island overnight.

22nd April 2007 (Julian Day 112)
Input Andy Chase and Jonnie Edmonston (4 hour communications job) to Bird Island before returning to the shallow mooring site. After a successful recovery, we returned to Bird Island, picked up Jonnie and headed to the deep water mooring site.

23rd April 2007 (Julian Day 113)
The deep water mooring was successfully deployed and we then headed towards the Shag Rocks area for whale pop-up work.

24th April 2007 (Julian Day 114)
Whale pop-up work with accompanying small swath surveys took up most of the day before a larger swath survey to the south of Shag Rocks off the continental shelf.

25th – 28th April 2007 (Julian Days 115-118)
Western core box acoustic work with a small amount of swath survey on the 28th April. Several core box transects were missed due to poor weather.

29th April 2007 (Julian Day 119)

Morning pick up of Andy Chase from Bird Island followed by an additional western core box transect and then transfer of Andy Chase back to King Edward Point.

30th April 2007 (Julian Day 120)
Passage between South Georgia and the South Sandwich Islands.

1st May 2007 (Julian Day 121)
We arrived at Protector Shoal early in the morning and gathered swath data between the mapped location of the Shoal and Zavodovski Island. There was a two hour gap in data acquisition due to a software problem.

2nd May 2007 (Julian Day 122)
Gathered swath from shallow areas near Zavodovski before moving north to the Proctector Shoal area. Towards the end of the day we moved south towards Candlemas Island.

3rd May 2007 (Julian Day 123)
The wind speed and sea state gradually picked up all day as we tried to circumnavigate Candlemas and Vindication Islands. We were reduced to only surveying in a northeast-southwest direction with speeds of only 4-5 knots possible against the wind. This left a large gap in the shallow area on the windward southwest of the island.

4th May 2007 (Julian Day 124)
Winds backed to the south and moderated slightly. Most of the day was spent traversing southwest-northeast lines between Candlemas and Visokoi Islands. We broke off into north-south lines later in the day to the between Visokoi and Zavodovski

5th May 2007 (Julian Day 125)
Most of the day was spent in the area around Visokoi Island in steadily improving conditions.

6th May 2007 (Julian Day 126)
The day was spent on the north and eastern flanks of Zavodovski. At this stage the weather was calm enough for tight turns to obtain full coverage of isolated bathymetric highs.

7th May 2007 (Julian Day 127)
The day was spent on the shallow southern side of Zavodovski as well as the western flanks and work to fill in gaps very close to the northern edge of the island. We proceeded north to the Protector Shoal area overnight.

8th May 2007 (Julian Day 128)
The last day of the main survey was spent in the shallow area in the vicinity of the mapped location of Protector Shoal. We then proceeded northwest towards Montevideo.

9th May – 14th May ((Julian Days 129-134)
Passage from the South Sandwich trench to Montevideo.

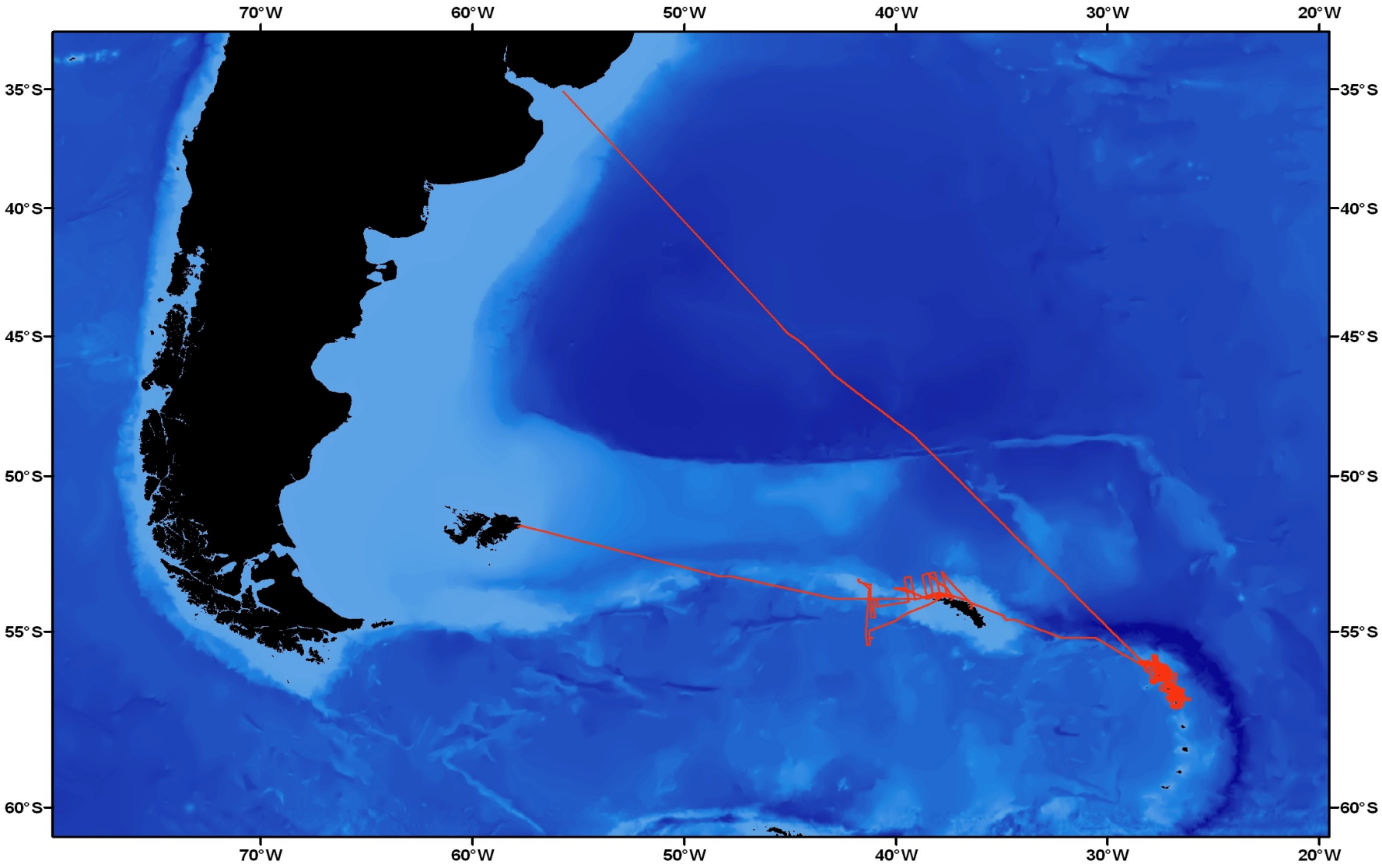


Figure 1 – Cruise track for the joint cruise JR167/168.

Equipment Report

EM120 Multibeam Echo Sounder

The EM120 acquisition system performed well but with some notable exceptions. The first was a 2/3 hour delay during the main survey when the system continued pinging but the ping and survey display did not update and no data was recorded. The EM120 was stopped and started on several occasion (both software interface and the hardware on/off switch) but with no positive outcome. The acquisition workstation was also rebooted and previous issues such as problematic sound velocity profiles (see JR134 cruise report) were discounted. Eventually closing and restarting the ping display window independently allowed the immediate resumption of data collection. While the exact cause is not known it may have been the result of a hanging process that was not killed by shutting down the Merlin acquisition software nor the reboot of the workstation. There were two other crashes during the survey but both were easily fixed by restarting the Merlin software whereupon data collection resumed.

The location of the main survey in an area of high relief presented problems for data acquisition. Survey planning prior to the event was possible for the deeper areas but couldn't predict the lines required to fill in shallow pinnacles rising from several 1000's meters. Although it is weather dependent, the practice of circumnavigating the islands and gradually moving inwards was a good one.

Extensive amounts of shallow areas were surveyed throughout the cruise and the EM120 had difficulty with bathymetry that was less than 100m when it was changing quickly. This is not unexpected as the EM120 is a deep water system. There was a tendency to lock onto false multiple returns on the upslope side of each ping in steeply dipping shallow areas. This was countered by forcing the depth almost continuously using the EA600 (bridge navigation single-beam sonar) depth as a guide. As the EM120 does not return data from throughout the water column, if a false bottom is consistently found it is leaves a large data gap.

Weather was only an issue for two days in the main survey area. However, even in gale force winds we were able to acquire usable swath data if the ship's heading was aligned with the primary swell direction. This made some areas of the survey area difficult to complete such as the windward west side of Candlemas Island but overall we were very fortunate to complete the area surveyed given the time of year.

Raw data were automatically copied onto the Neptune workstation every minute, and stored in one-hour files to the path:

/data/cruise/jcr/current/em120/raw/*'survey name'*

where current is a symbolic link to the leg id 20070418 (date the cruise started)

The cruise was spilt up into five surveys:

JR168_a was the transit between Stanley, FI and the South Georgia shelf area.

JR168_b includes all the shelf and near shelf data collected around South Georgia during the western core box cruise JR167.
JR168_c was the deep water transit between South Georgia, the deep water mooring site and the whale pop-up locations near Shag Rocks.
JR168_d was the main survey area around Zavodovski, Visokoi, Candlemas and Protector Shoal areas. It also includes deep water transits from South Georgia and across the South Sandwich Trench towards Montevideo.
JR168_e was the transit from the South Sandwich Trench to Montevideo.

Data were processed with MB System v5.0.9 following the same general procedures detailed in the JR93 and JR134 cruise reports. A previously reported problem on JR134 concerning updated Simrad datagrams and MB System v5.0.7 has now been fixed.

Copying the data and producing auxiliary files

The perl script *mbcopy_em120* was used to copy raw EM120 data into MB system format and produce auxiliary files. To run the script type, 'setup gsd' and then 'mbcopy_em120' from a Unix command line. You will be asked several questions regarding the raw data location, the desired location of the copied data and whether you want all the lines copied (type 'n' if you are actively acquiring data and the script will not copy the last hour file as it will not be complete). This information will be stored in a defaults file in your home directory and will not need to be re-typed until you change survey names. Note that the script will check for lines already copied and will ignore these. You can however, force the script to start at a predetermined line number if you do not want the earlier line numbers copied.

Cleaning the data

All of the data cleaning was done manually using the mbedit graphical interface. This allows the user to manually flag data in either a ping-by-ping view or as a waterfall view where n number of pings can be viewed together. Detailed editing was done using the ping-by-ping view for each hour file followed by a quick look using the waterfall view to check for any erroneous depth values missed.

Cleaning the data creates two additional files, a .esf file which holds the flagging information and a .par file which contains a whole variety of edits including cleaning and navigation fixes. Navigation data was not a problem during JR168 so did not need fixing.

Processing the data

The command *mbprocess* takes information from the .par file and processes the .mb57 data to produce a final output file. If the input file is called data.all.mb57, the processed file becomes data.allp.mb57. *mbprocess* also creates additional auxillary files (.inf, .fnv, .fbt). The command takes the form of:

```
mbprocess -Iraw_datalist -F-1
```

A text file containing the names of all the processed data can then be created (proc_datalist on this cruise, i.e type, 'ls *.allp.raw.mb57 > proc_datalist'). If at some point the user decides to go back and re-clean the data or edit the navigation for a single file, mbprocess can be run with the same command and it will process only the newly edited files.

To recap the processes and the files they create are:

Input	Process	Output
Data.all.raw	mbcopy	Data.all.raw.mb57
Data.all.raw.mb57	mbdatalist	Data.all.raw.mb57.inf
		Data.all.raw.mb57.fbt
		Data.all.raw.mb57.fnv
Note : The above two processes are combined in the script em120_mbcopy		
Data.all.raw.mb57	mbclean/mbedit	Data.all.raw.mb57.esf
		Data.all.raw.mb57.par
Data.all.raw.mb57	mbnavedit	Data.all.raw.mb57.nve
		Data.all.raw.mb57.par (modified)
Data.all.raw.mb57	mbprocess	Data.allp.raw.mb57
		Data.allp.raw.mb57.inf
		Data.allp.raw.mb57.fbt
		Data.allp.raw.mb57.fnv

Gridding the data

The command *mbgrid* with its associated options produces a user-defined grid for viewing the cleaned swath results. Data was output directly to ArcGIS ascii grids as ArcGIS was the primary software tool used to view the grids. One of the limitations of ArcGIS grids is the need for matching x and y grid resolution. Hence, it was necessary to use identical values in degrees (usually 0.001 or 0.002) that are unequal in distance. A grid resolution of 0.002 degrees is approximately equal to 62m (longitude) x 111m (latitude). The command and some of the more common options used are:

```
mbgrid -Iproc_datalist -O 'grid filename'
-R-29/-26/-57/-55 (bounding co-ords, min long/max long/min
lat/max lat)
-E0.002/0.002/degrees (grid resolution; 0.002 degrees in this
case)
-G4 (Specifies an ArcGIS ascii grid output)
-F1 (type of filter used; 1=gaussian weighting, 2=median
weighting)
-C5 (spline interpolation into data free areas, 1500m in this
case (grid resolution x 5)
```

Ascii xyz files were also produced from the cleaned data using the command *mblist* and the following options

```
mblist -Iproc_datalist -F-1 -D2 > survey_name.mbxyz
```

-D2 is the output format (simply X,Y,Depth) and the output text file can be called anything you like. The file suffix 'mbxyz' was used to avoid confusion with Neptune 'xyz' files.

The mbxyz files can be used as an input to the GMT nearneighbor command or any other gridding software that accepts ascii xyz files.

Generated ascii grid files were converted into ArcGIS binary grids using the ArcGIS tool 'Ascii to raster'. They could then be viewed and manipualted using ArcGIS v9.2 and this proved a very useful tool for finding data spikes that needed further cleaning.

File Structure

A common file structure was created to hold all the mb data located under

/data/cruise/jcr/20070418/work/mb_data/*'survey_name'*

Each survey_name (e.g. jr168_a) directory contains processing, grd and mbxyz subdirectories. The processing directory holds all the copied mb57 raw files, the edits and the processed mb57 files. The grd directory holds any GMT grids or ArcGIS ascii grids while the mbxyz directory holds the xyz text output.

Recommendations for MB system v5.0.9

1) In areas of great depth variation it was necessary to keep changing the horizontal scale and vertical exaggeration within the mbedit window. It would be desirable for the software to best fit the displayed pings to the window automatically. An option would allow the best fit of all beams or just those that are unflagged.
2) Mbgrid doesn't have an option to multiply all values by –1 i.e. turn positive depths into negative depths. Instead an extra step has to be performed in ArcGIS. It would be desirable to have an option in mbgrid where depths can be returned as negative.

Expendable Bathy Thermographs (XBT)

XBTs were used where necessary throughout the cruise to provide the correct sound velocity profile for the EM120. In the main survey area there was very little difference in water column properties and only two XBTs were needed. More were required for the transit legs as we passed through the Polar Front. As in previous cruises, we used archive XBT data collected on previous cruises when launching an XBT would have been impractical such as in rough weather. A full list of XBT locations can be found in Appendix A.

Magnetometer

The SeaSpy towed magnetometer is an enhanced proton precession instrument, which makes use of the so-called 'overhauser effect' to increase sensitivity and reduce power requirements. It was deployed during the Falklands to South Georgia transit and on the transit from the South Sandwich Trench to Montevideo. Operation was faultless, and high quality data obtained throughout its operation. Towing depth was always less than a metre or two beneath the surface at tow speeds of up to 11 knots. Magnetic data was continuously recorded to the SCS.

Summary

Shag Rocks Continent-Ocean boundary

A few hours of opportunistic time were spent mapping the continent-ocean boundary along the southern flank of the Shag Rocks continental block (Figure 2). The survey revealed what appears to be a system of extensional normal faults displacing crustal blocks downward successively to the south, in a manner reminiscent of the sides of a rift zone. The survey can be interpreted to identify the southern limit of the continental crust in this area.

South Sandwich arc

The survey of the South Sandwich arc was highly successful. It revealed the underwater morphology of most of the northern part of the arc in considerably greater detail than known hitherto. The survey extends between 55° 45′S and 57° 20′S and includes Protector Shoal and the areas around the islands of Zavadovski, Visokoi and the Candlemas island group. The survey reveals a substantial amount of information about the volcanic forms and evolutions of the underwater parts of the arc (Figure 3).

Protector Shoal: The entirely submarine Protector Shoal area is close to the northern limit of the arc and is seen to form an east-west-trending seamount chain. The shallowest seamount rises to approximately 50 m of the surface. Some of the seamounts appear to be monogenetic (formed in a single eruption). The highest seamount, to the northeast of the previously identified position of Protector Shoal, consists of a cone with a south-facing breached crater from which a viscous lava flow appears to have emerged. The seamount at the western end of the chain also appears to be a breached volcanic cone.

Zavodovski: This was revealed to be the largest single volcanic edifice. There are extensive shallow and relatively flat-topped (probably due to erosion by iceberg scouring) shoals to the east of the island. The subaerial volcano is situated toward the western edge of the whole edifice, with significantly steeper slopes to the west than to the east of the edifice. This appears to be evidence for westward migration of the volcanic focus relative to the underlying plate. There is a distinct ridge extending from the southern flank of the volcano toward the southwest, in the direction of Leskov Island (not surveyed). The submerged slopes of the island are dominated by collapse structures, with numerous embayed landslide scarps. Several areas having bumpy or corrugated surfaces appear to emerge from the landslide scars, and are interpreted as debris flow deposits.

Visokoi: This is the smallest of the three main volcanic edifices. Slopes on the north, west and south are notably steep. There is smooth, gently sloping plateau on the east side of the island that probably has been planned by iceberg scoring. This plateau is continuous with a ridge that extends to the southeast, where it appears to join with a ridge extending to the northeast from Candlemas. The present island is asymmetrically situated to the west end of the edifice as a whole. The eastern slopes are dominated by features interpreted as landslip scars.

Candlemas Group: Like Zavodovski and Visokoi, the Candlemas edifice is steeper on its western than its eastern flank, with the current subaerial volcano asymmetrically situated toward the west. The ridge extending to the northeast of the volcano appears to join with the ridge extending southeast from Visokoi. If the ridges represent the track of the melting anomalies, it appears that the two volcanoes originated from a common melting anomaly that slit into two which progressively separated, resulting in the V-shaped bathymetric pattern. There are numerous structures interpreted as landslide scars of the eastern flanks and southern flanks of the volcano.

Acknowledgements

We are very grateful to Captain Graham Chapman and his team of officers and crew of the RRS James Clark Ross for their enthusiastic support of the survey work.

References

Baker, P.E. 1990. South Sandwich Islands. In: LeMasurier, W.E. & Thomson, J.W. (eds.) *Volcanoes of the Antarctic Plate and Southern Oceans*. Antarctic Research Series, American Geophysical Union, 48, 361-395.

Gass, I.G., Haris, P.G. & Holdgate, M.W. 1963. Pumice eruption in the area of the South Sandwich Islands. *Geological Magazine*, 100, 321-330.

Holdgate, M.W. & Baker, P.E. 1979. The South Sandwich Islands: I. General description. *British Antarctic Survey Scientific Reports*, 91.

Larter, R.D., Vanneste, L.E., Morris, P. & Smyth, D.K. 2003. Structure and Tectonic evolution of the South Sandwich arc. In: *Intra-Oceanic Subduction Systems: Tectonic and Magmatic Processes*. Geological Society, London, Special Publications, 219, 255-284.

Leat, P.T., Smellie, J.L., Millar, I.L. & Larter, R.D. 2003. Magmatism in the South Sandwich arc. In: *Intra-Oceanic Subduction Systems: Tectonic and Magmatic Processes*. Geological Society, London, Special Publications, 219, 285-313.

Leat, P.T., Larter, R.D. & Millar, I.L. 2007. Silicic magmas of Protector Shoal, South Sandwich arc: indicators of generation of primitive continental crust in an island arc. *Geological Magazine*, 144, 179-190.

Pearce, J.A., Baker, P.E., Harvey, P.K. & Luff, I.W. 1995. Geochemical evidence for subduction fluxes, mantle melting and fractional crystallization beneath the South Sandwich arc. *Journal of Petrology*, 36, 1073-1109.

Tomblin, J.F. 1979. The South Sandwich Islands: II. The Geology of Candlemas Island. *British Antarctic Survey Scientific Reports*, 92.

Figure 2 – Shaded relief of the opportunistic survey JR168_c to the south of Shag Rocks.

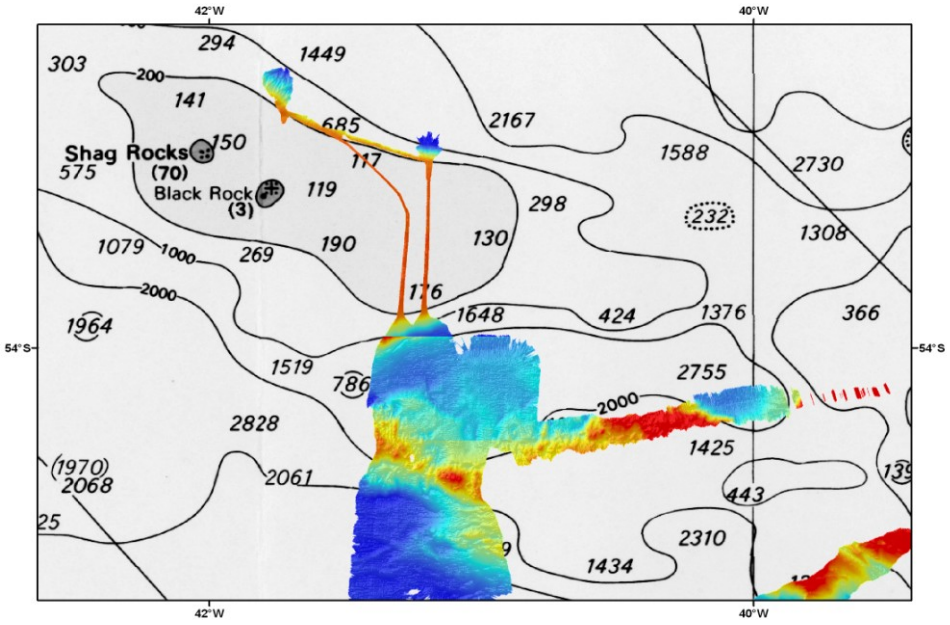
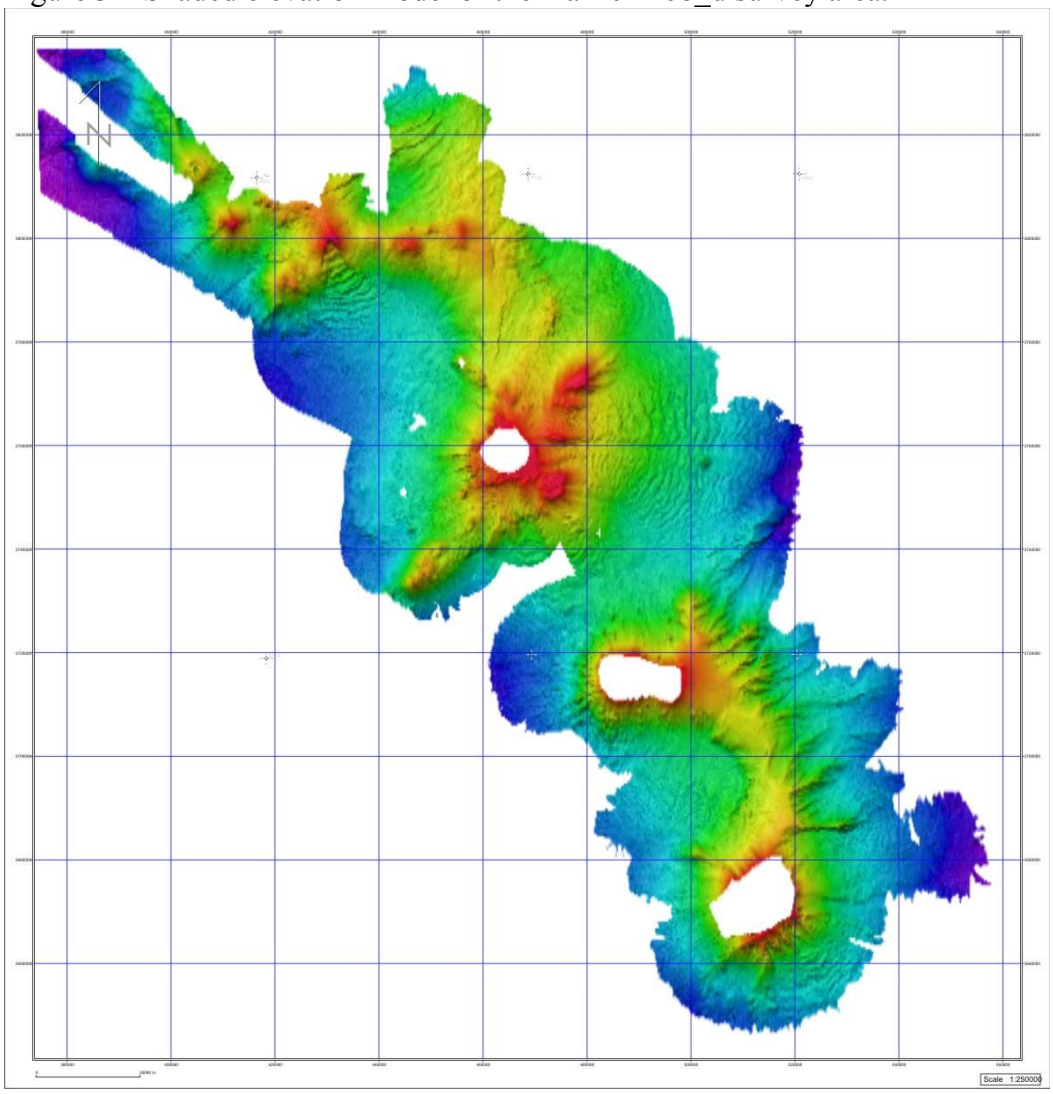


Figure 3 – Shaded elevation model of the main JR168_d survey area.



Appendix A

Date/Time	Latitude	Longitude	Depth (m)	Wind speed (ms^{-1})	Comment
18/04/2007 18:42	-53.9977	-39.6819	751.59	18.4	EM120 started and logging to JR168_a (Stanley to South Georgia passage) at line 1. Using sound velocity profile JR116_002.asvp.
18/04/2007 20:14	-51.8246	-56.7489	521.81	11.1	Ship emergency brake testing
18/04/2007 20:58	-51.8331	-56.6395	669.81	11.4	Brake trial completed. Towed magnetometer deployed.
18/04/2007 21:44	-51.8798	-56.395	989.77	17.4	Sound velocity profile changed to JR134_004.asvp. Improved profiles.
18/04/2007 22:25	-51.9157	-56.2032	1019.31	16	XBT 1 launched - not uploaded as svp upload software was not working.
19/04/2007 23:25	-53.2836	-48.2975	3297.25	13.4	Sound velocity profile changed to jr73_048.asvp as we have passed through the Polar Front.
20/04/2007 20:24	-54.0016	-41.473	1786.88	15	Sound velocity profile changed to jr100_030.asvp.
20/04/2007 22:40	-53.9991	-40.7489	2688.82	12.7	Magnetometer recovered.
21/04/2007 02:08	-53.9977	-39.6819	751.59	18.4	Started survey JR168_b on line 1 (South Georgia area).
21/04/2007 09:45	-53.7998	-37.9309	269.08	25.2	Stopped EM120 logging as at shallow mooring site.
21/04/2007 11:59	-53.8026	-37.9199	256.38	11.8	Start EM120 logging
21/04/2007 17:45	-54.2807	-36.4659	140.24	11.6	Stopped EM120 logging at King Edward Point boat transfer area in Cumberland Bay.
21/04/2007 18:22	-54.2808	-36.4659	143.62	10.2	Start EM120 logging
22/04/2007 07:35	-53.896	-37.8781	76.79	6.3	Stopped EM120 logging and off as approaching Elsehul.
22/04/2007 10:49	-53.9787	-37.9891	75.81	8.4	Start EM120 logging
22/04/2007 11:46	-53.7998	-37.9403	317.89	16.3	Stopped EM120 logging at shallow mooring site.
22/04/2007 13:54	-53.8717	-38.0093	139.25	21.7	Start EM120 logging
22/04/2007 14:45	-53.9961	-38.1001	56.19	25.3	Stopped EM120 logging approaching Bird Island.
22/04/2007 19:24	-54.0405	-38.096	94.69	21.4	Start EM120 logging
22/04/2007 23:43	-54.3906	-39.2965	382.77	18.9	Stopped survey JR168_b at line 36. Started survey JR168_c (Deep water off South Georgia shelf plus Shag Rocks) at line 1.
23/04/2007 07:00	-54.9401	-41.1071	3271.34	32.2	Stopped EM120 logging at deep mooring site.
23/04/2007 18:10	-55.1959	-41.1274	3131.59	26.7	Start EM120 logging
24/04/2007 10:08	-53.4465	-41.7281	184.72	20.3	Stopped EM120 logging at first whale pop-up.
24/04/2007 10:13	-53.4465	-41.7281	182.97	19.6	Start EM120 logging for small survey round pop-up site.

Date/Time	Latitude	Longitude	Depth (m)	Wind speed (ms^{-1})	Comment
24/04/2007 12:02	-53.4487	-41.7277	165.14	22.2	Stopped EM120 logging at first whale pop-up.
24/04/2007 12:42	-53.4456	-41.7285	192.51	26.3	Start EM120 logging
24/04/2007 15:58	-53.5726	-41.1965	192.49	25.8	Stopped EM120 logging at second whale pop-up.
24/04/2007 16:54	-53.5678	-41.1923	206.68	9.8	Start EM120 logging
25/04/2007 09:00	-54.1015	-39.5425	1385.89	38.5	Stopped EM120 logging at start of JR167 western core box accoustics.
28/04/2007 00:55	-53.9604	-37.3294	139.53	8.8	Start EM120 logging for short run from Rosita Harbour to start of core box transect 3.1. Logging to survey JR168_b line 51. Lines 37 - 50 do not exist.
28/04/2007 09:00	-53.9017	-38.1389	123.45	17.7	Stopped EM120 logging starting 3.1 transect.
29/04/2007 03:07	-53.8761	-38.105	209.18	34.5	Start EM120 logging for short run near shallow mooring site.
29/04/2007 09:00	-53.9984	-37.9958		25.3	Stopped EM120 logging approaching Bird Island.
29/04/2007 16:38	-53.1407	-37.8236	3337.54	38.1	Start EM120 logging at end of final western core box transect heading towards King Edward Point.
29/04/2007 23:30	-54.2159	-36.4419	250.26	25.7	Stopped EM120 logging at King Edward Point boat transfer area in Cumberland Bay.
30/04/2007 00:19	-54.2732	-36.4468	253.17	14.2	Start EM120 logging onto survey JR168_b line 74 heading towards the South Sandwich Islands.
30/04/2007 07:19	-54.4989	-34.9842	1112.01	34.1	Survey JR168_b stopped. Survey JR168_d started.
30/04/2007 12:00	-54.7672	-33.9626	2615.89	27	XBT 2 deployed (17th of joint cruise).
30/04/2007 12:12	-54.7844	-33.8944	2529.15	24.9	Sound velocity profile changed to jr168_017.asvp.
30/04/2007 19:58	-55.1817	-31.0785	4886.17	8.5	XBT 3 deployed (18th of joint cruise).
30/04/2007 20:06	-55.1806	-31.0462	5059.85	8.7	Sound velocity profile changed to jr168_018.asvp.
01/05/2007 14:55	-56.1049	-27.7028	1422.91	26.1	XBT 4 deployed (19th of joint cruise).
01/05/2007 16:29	-56.3024	-27.6924	775.64	32.3	Sound velocity profile changed to jr168_019.asvp.
01/05/2007 23:03	-56.2434	-27.4312	372.81	22	EM120 stops collecting data though pings are still being transmitted. Last good hour file is line 41.
02/05/2007 01:33	-56.2009	-27.6533	1115.76	26.8	EM120 resumes operation after a lengthy delay. Various fixes were tried involving shutting down the swath and the server but ultimately it may have been caused by the ping display window. Closing and reopening this window immediately restarted normal data acquisition. Lines 42-44 were mainly rubbish, lines 44-46 do not exist and line 47 was started on

Date/Time	Latitude	Longitude	Depth (m)	Wind speed (ms^{-1})	Comment
					an incorrect sound velocity profile. Data starts properly on line 48.
02/05/2007 17:32	-56.4549	-27.2677	1459.25	33.3	EM120 stops pinging for 5 minutes. Stopping and restarting the sonar gets things going again.
05/05/2007 16:00	-56.4979	-27.1708	1790.97	25.2	XBT 5 deployed (20th of joint cruise).
05/05/2007 16:30	-56.5731	-27.193	1657.71	25.4	Sound velocity profile changed to jr168_020.asvp.
06/05/2007 09:30	-56.2348	-27.3971	266.06	7.8	Ran out of disk space on the EM120 acquisition workstation.
06/05/2007 09:45	-56.2129	-27.3905	252.74	16.8	EM120 disk space issue sorted and acquiring data again.
06/05/2007 19:47	-56.1948	-27.3303	5.81	19.7	EM120 crashes giving a message saying processing unit can not be found. The operator interface restarts without a problem.
08/05/2007 12:00	-55.8762	-28.415	1030.73	20.7	Magnetometer deployed.
08/05/2007 18:07	-54.9553	-29.8695	6917.61	20	Sound velocity profile changed to jr168_018.asvp.
08/05/2007 22:36	-54.2428	-30.9716	5138.52	13.4	Survey JR168_b stopped at line 224. Survey JR168_e started.
09/05/2007 12:19	-48.5423	-39.24	5468.74	34.3	XBT 6 deployed (21st of joint cruise).
09/05/2007 12:23	-52.179	-34.1238	3678.72	24.5	Sound velocity profile changed to jr168_021.asvp.
09/05/2007 18:31	-51.2177	-35.4851	4909.29	24.8	Sound velocity profile changed to jr72_070.asvp.
10/05/2007 13:10	-48.5423	-39.24	5468.74	34.3	XBT 7 deployed (22nd of joint cruise).
10/05/2007 13:14	-48.5341	-39.2534	5456.61	28	Sound velocity profile changed to jr168_022.asvp. Previous 12 hours may benefit from this svp.
10/05/2007 14:50	-48.3515	-39.5865	5734.9	35.1	XBT 8 deployed (23rd of joint cruise).
10/05/2007 14:53	-48.3452	-39.5961	5739.35	36.2	Sound velocity profile changed to jr168_023.asvp.
12/05/2007 14:45	-42.3522	-47.9593	5395.9	14.9	XBT 9 deployed (24th of joint cruise).
12/05/2007 15:30	-42.2296	-48.0993	5453.62	15.2	Sound velocity profile changed to jr168_024.asvp.
13/05/2007 13:37	-38.5069	-52.0805	4578.54	4	XBT 10 deployed (25th of joint cruise).
13/05/2007 14:00	-38.454	-52.1367	4529.77	8.3	Magnetometer recovered.
13/05/2007 14:10	-38.4277	-52.1618	4499	4.9	Sound velocity profile changed to jr168_025.asvp. Previous 12 hours probably need changing to it as well.
13/05/2007 17:00	-37.9598	-52.6457	4051.6	5.4	EM120 stopped logging and off approaching the 200 mile limit.