



The 2016 Cordell Expedition to Heard Island

Discovering Life in the Extremes



Post-Expedition Report to the Australian Antarctic Division (AAD)

Robert W. Schmieder
Organizer/Expedition Leader

Version AAD_Report_5.1.3.docx

Date: 18 Feb 2017

Cordell Expeditions
4295 Walnut Blvd.
Walnut Creek, CA 94596
(925) 934-3735
schmieder@cordell.org
www.cordell.org

CONTACTS AND COPYRIGHT

This document is one of a collection of documents describing various aspects of the 2016 Cordell Expedition to Heard Island, Territory of Australia, located in the Southern Ocean, carried out during March/April, 2016. It is issued by:

Robert W. Schmieder, Ph.D.
Organizer/Expedition Leader
(925) 934-3735
schmieder@cordell.org

Information about Cordell Expeditions can be found online at:

Cordell Expeditions
4295 Walnut Blvd.
Walnut Creek, CA 94596
<http://www.cordell.org>

The websites for the 2016 expedition were

<http://www.heardisland.org>
<https://vk0ek.org>



COPYRIGHT © 2016 Robert W. Schmieder

The material within this document is protected by copyright. While you are free to quote parts of this document, you may not reproduce or distribute substantial portions or the entirety of this document, and you may not extract the images for reproduction or distribution by any means, without the written permission of Cordell Expeditions.

SUMMARY

The 2016 Cordell Expedition to Heard Island was the first scientific expedition to this extreme and extremely remote island in almost 15 years. The two-month, half-million-dollar expedition took nearly 4 years to plan and prepare. The actual voyage started in early March, 2016, in Cape Town, South Africa. After a 12-day voyage, the team of 14 men reached Heard Island at 53°S 73°E, where they spent 3 weeks documenting significant changes in the 2-mile-high volcano, glaciers, lagoons, and wildlife that have occurred over the past decade, and exploring areas not previously visited. They were the first to enter and document the two-mile-wide lagoon created in the past ten years by the melting of a major glacier, and the first to collect samples of rocks, sediment, and water from there.. The return voyage ended in late April in Fremantle, Western Australia.

In addition to the onsite scientific work, the team also carried out an amateur radio operation that logged 75,000 contacts worldwide, including several firsts such as remote radio operation. They also implemented a large number of infotech innovations, much of it based on satellite-accessed internet resources, including a live online help desk, the first *remote* radio operation, the real-time web radio log display, and live Skype interviews with journalists and schools. Through the website, blog, Facebook, Twitter, Newsletter, and numerous interviews and presentations, this expedition significantly raised the standard for outreach and interactivity for remote scientific projects.

This document is the Final Report to the Australian Antarctic Division (AAD) on the expedition, in fulfilment of the requirements of the Permit issued 1 March 2016.

Figures whose captions are marked with the symbol ● have a hyperlink. Press <ctrl>-click to download.

ADDITIONAL INFORMATION

The main website www.heardisland.org contains extensive documentation of the project, including the visitor permit, radio license, biographies of the team members and other participants, news releases, Newsletters, the AudioLog, QSL information, order forms for souvenirs, detailed descriptions of the scientific projects, and FAQ, information for sponsors and participants, policies, a Heard Island library, a full copy of *VKØIR Heard Island*, the book about the 1997 expedition by the author of this report, and various other documents. A full listing of the contributors is on the main website www.heardisland.org (links /TEAM/ and /SPONSORS/). Information on the sponsoring organization Cordell Expeditions can be found on the website www.cordell.org. All the VKØEK Newsletters can be downloaded from www.heardisland.org/HD_pages/HD_newsletter_back_issues.html. You can hear the daily verbal reports made during the expedition on the AudioLog at <https://media.vk0ek.org/>. You can download the full poster of the team and logistics on the world map from www.heardisland.org/HD_documents/HD_Poster_2.5.pdf. The blog website for the DXpedition is <https://vk0ek.org>. On Facebook go to <https://www.facebook.com/heardisland2015/> and on twitter go to <https://twitter.com/vk0ek>. Souvenir mugs and shirts can be obtained through the web page <https://shop.vk0ek.org/souvenirs.html>.

THE AUTHOR

The 2016 expedition to Heard Island was organized and led by Dr. Robert Schmieder. He is the founder of the nonprofit oceanic research organization Cordell Expeditions, which has to its credit more than 1000 discoveries, including new species, range and depth extensions, and first observations. His research expeditions were instrumental in the establishment of the Cordell Bank National Marine Sanctuary, which is the subject of permanent exhibits in the Oakland Museum and the Pt. Reyes National Seashore. Besides Cordell Bank, his more significant expeditions include Peter I (Antarctic), Easter Island, a previous expedition to Heard Island (in 1997), San Felix Island (Chile), Kure Atoll (Hawaiian Islands), and Clipperton Island. He is the author of seven expedition books and is honored by four named species and an oceanic site (Schmieder Bank) and numerous other awards, including the Amateur Radio Hall of Fame.



DEDICATIONS

The 2016 Cordell Expedition to Heard Island held the following honors:

Honorary Principal Scientist	Edward O. Wilson
Expedition Dedication	The Fourteen Men (ANARE 1947)
Honorary Expedition Leader	Jean-Michel Cousteau
DXpedition Dedication	Jim and Kirsti Smith
Honorary DXpedition Leader	Joseph Taylor

For their extraordinary advice and collaboration on and about Heard Island,
This document is dedicated to:

Eric Woehler
Grahame Budd

(Opposite) Mawson Peak capping Big Ben looms above the waters of Atlas Cove. Photo 30 March 2016

ABOUT THIS DOCUMENT

THIS IS AN UPDATED DOCUMENT

This is the Final Report of the 2016 Cordell Expedition to Heard Island, prepared in accordance with the Permit issued by the Australian Antarctic Division (AAD).

This document has a version number, indicated on each page and shown here:

**Version AAD_Report_5.1.2 rev_1.docx
18 Feb 2017**

The document is available on the web at

http://www.heardisland.org/HD_documents/AAD_Final_Report/5.1.2.pdf

This document is organized in the following sections:

- | | |
|---------------------------------------|---|
| 1. BACKGROUND | Concept, goals, budget, and other plans for the expedition |
| 2. PREPARATION | Organization, support, acquisitions, logistics |
| 3. THE VOYAGE | Travel to and return from Heard Island |
| 4. OPERATIONS ON THE ISLAND | Activities conducted during the stay on the island |
| 5. FIELD RESEARCH ON THE ISLAND | Environmental conditions, emphasis on climate-related changes |
| 6. SPECIMENS | Collection and processing of specimens |
| 7. INFOTECH | Web-based services and outreach |
| 8. AMATEUR RADIO | Operations to log contacts with radio operators worldwide |
| 9. ENVIRONMENTAL DATA | Buoy deployment, temperature, illumination, seabird populations |
| 10. LOGS | Instrumental and personal logs |
| 11. EVIDENCE OF RECENT CHANGE | Evidence for recent changes linked to climate |
| 12. SUMMARY OF RESULTS | Summary of the activities that produced results |
| 13. CONFORMANCE TO THE PERMIT | Details of conformance to the Permit |
| 14. RECOMMENDATIONS FOR FEATURE NAMES | Sites for which names could be assigned |
| 15. ACKNOWLEDGMENTS | Supplementary documents related to the project |

It is not intended that this document be exhaustive—the analysis and interpretation of data and specimens from the expedition will continue for considerable time. It is expected that this document will undergo many revisions; hence it is strongly recommended that you obtain the most recent version from the URL above.

If you refer to material in this document, please attach the version number, listed on each page.

Errors, corrections, and other suggestions will be warmly received. Please send them to the author at the addresses listed on p. ii.

THIS IS AN UPDATED DOCUMENT

CONTENTS

CONTACTS AND COPYRIGHT	ii
SUMMARY	iii
ADDITIONAL INFORMATION	iii
THE AUTHOR	iii
DEDICATIONS	v
ABOUT THIS DOCUMENT	vi
CONTENTS	vii
1. BACKGROUND	1
2. PREPARATION	2
Planning	2
Development	3
Documentation	4
Outreach	9
The team	10
Vessel	10
Logistics	11
3. THE VOYAGE	13
Vessel track	13
Buoy deployment	14
Onboard	16
4. OPERATIONS ON THE ISLAND	17
Overview	17
Atlas Cove	18
Laurens Peninsula	36
Stephenson Lagoon	37
5. FIELD RESEARCH ON THE ISLAND	43
Overview	43
Atlas Cove	44
Laurens Peninsula	92
Stephenson Lagoon	104
6. SPECIMENS	140
Locations	140
Handling of the specimens	146
List	148
Rocks	150
Soil/sediment	152
Terrestrial invertebrates	153
Marine invertebrates	154
Plants	155
Water	156
7. INFOTECH	158
Overview	158
Help Desk	158
Skype conferences	159
Social media	160
Websites and blogs	160
DXA	161
8. AMATEUR RADIO	162
Statistics of the VKØEK operation	164
Propagation	166
9. ENVIRONMENTAL DATA	167
NOAA drifters	167
WHOI diving buoys	171
Seabirds	173
Synoptic weather charts from Braveheart	176
Weather at the campsite	178
Model of the wind at the campsite	181

Temperature-illumination Atlas Cove	184
Article on debris.....	187
10. LOGS	188
Daily reports to the AAD	188
Audio logs	195
Gavin Marshall journal.....	212
Jim Colletto journal	221
11. EVIDENCE OF RECENT CHANGE	226
Growth of Mawson Peak	227
Glacial erosion – ice slumping.....	228
Breakwater degradation	230
Land erosion – Red Island isthmus.....	231
Glacial retreat – Lagoon formation	232
Lagoon disappearance, subsurface streams	233
Historical photos	234
12. SUMMARY OF RESULTS	238
Accomplishments.....	238
Activities not done	240
13. CONFORMANCE TO THE PERMIT	242
14. RECOMMENDATIONS FOR FEATURE NAMES	244
Islet in Sydney Cove	245
Isthmus connecting to Red Island	246
Glacier west of Stephenson Lagoon.....	247
Tarn west of Stephenson Lagoon.....	248
Island east of Stephenson Lagoon	249
15. ACKNOWLEDGMENTS.....	250
The Cordell Expeditions team	250
Acknowledgments.....	252

1. BACKGROUND

Since 1978, Cordell Expeditions (CE) has organized and carried out a series of exploratory expeditions to very remote oceanic sites. These include the following, among others:

- Cordell Bank (California)
- Peter I Island (Antarctic)
- Easter Island (Ecuador)
- Heard Island (Australia)
- San Felix Island (Chile)
- Kure Atoll (Hawaii)
- Clipperton Island (France)

The expeditions have resulted in more than 1000 records, including new species, range and depth extensions, and first observations; seven books; numerous journal and popular articles; two permanent museum exhibits; and a national marine sanctuary. The main website for CE is <http://www.cordell.org>, although there are several derivative project-specific websites, including <http://www.cordell.org/EI/index.html>, <http://www.cordell.org/HI/index.html>, <http://www.cordell.org/SFX/index.html>, <http://www.cordell.org/KURE/index.html>, <http://www.tx5k.org/>, and <http://www.vk0ek.org>.

In 1997, CE carried out an amateur-radio expedition to Heard Island, in the Southern Ocean. This project set numerous world-records and defined a new standard for remote radio operations. That project is fully described in the book by the author of this report *VKØIR: Heard Island* (CE 1997).

In 2012, the author decided to return to Heard Island to carry out a multi-discipline project involving

- Field science
- Infotech
- Amateur radio

A large part of the motivation for the expedition was that there had not been a scientific expedition for almost 15 years, nor a radio operation for nearly 20 years. Several factors had changed significantly since the 1997 expedition:

- Cost of transportation
- Permit requirements
- Internet communications
- Social media

As a consequence, it took three years to plan, organize, and fund the expedition before it could finally be carried out in March/April, 2016. Among the first tasks undertaken was to initiate a Project Description document. This was akin to a business plan; it evolved through dozens of versions, the last made shortly before the expedition. This document was used as the main reference for stating the goals and objectives, defining the tasks, applying for permits, fundraising, team building, and the mundane tasks of assembling reference, descriptions, graphics, and other resource material necessary to support the effort.

As the project progressed, numerous difficulties were encountered, including vessels that did not keep agreements, team members withdrawing, and extensive documentation required for the permits to visit and to collect specimens. By the winter of 2015, the resources were in place, and the expedition was carried out with a team of 14 men over a 2-month period, at a total cost of about US\$500,000. The results, although less than hoped due to extreme weather and other factors, were nevertheless extensive. This document summarizes some of these.



Figure 1 – The Project Plan

2. PREPARATION

Planning

The Project Description document was more a planning aid than a definition of the project. It was typically about 100 pages, organized into the following sections:

A CONSPECTUS OF THE PROJECT
ENVIRONMENTAL SCIENCE
COMMUNICATIONS SCIENCE
OPERATIONS
PROJECT MANAGEMENT
SUMMARIES
SUPPLEMENTARY
INFORMATIONI

The document was last updated on 8 Oct. 2015, because other documents, especially the permit application, were in progress. This document, as well as all other project documents, remains available on the website.

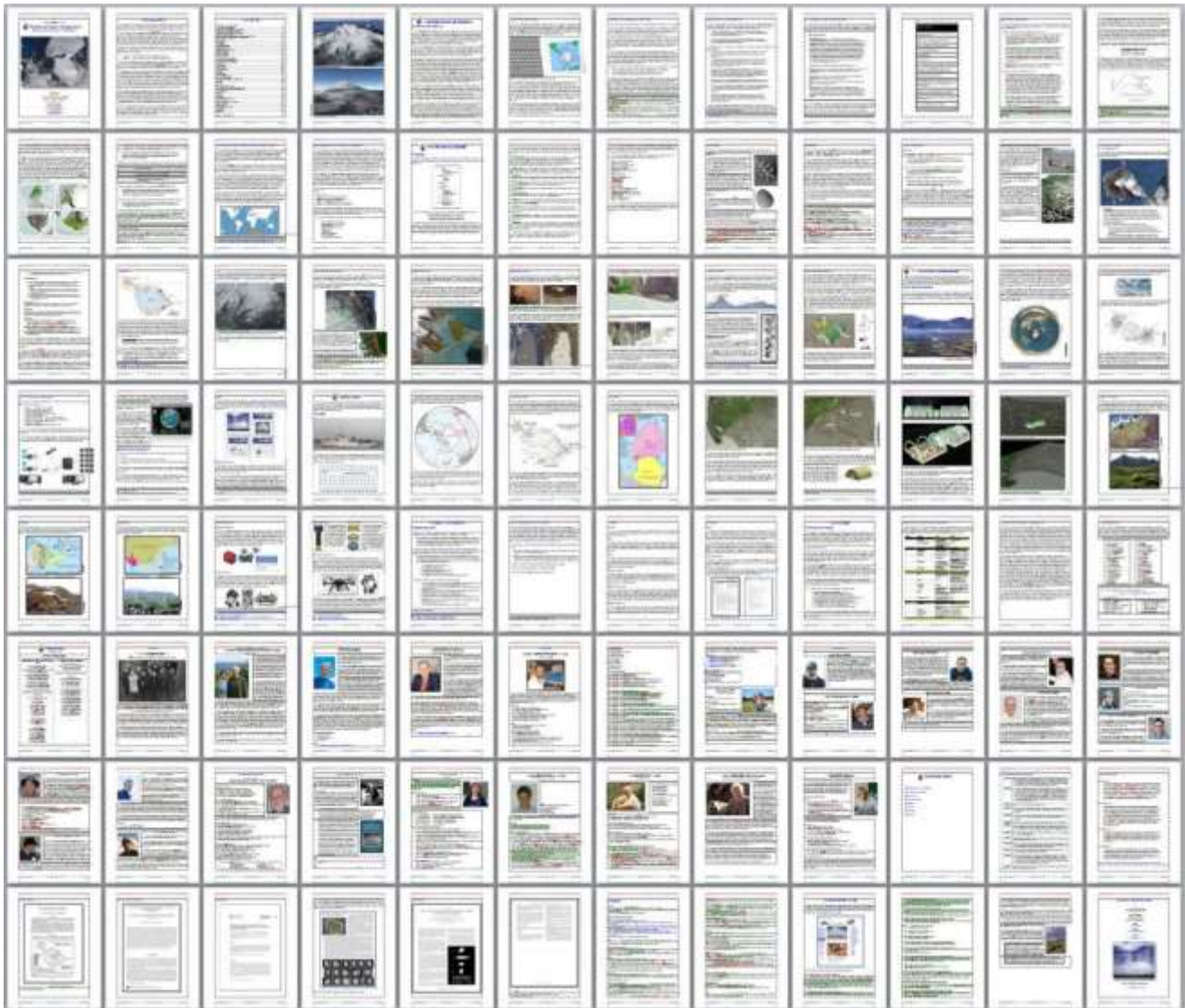


Figure 2 – All pages of the Project Description ●

Development

Two of the three project disciplines, namely infotech and amateur radio, were adopted as challenges: to develop innovative advances for remote operation, especially for enhanced outreach and communications with supporters, sponsors, and the public. With developments in internet and social media, a large number of options were rather suddenly available for an expedition, and the author, together with his principal partner and co-organizer Rich Holoch, began to define various innovative technologies that could be implemented.

With the assembly of a local (Northern California) support team, periodic meetings and working sessions were held to define, implement, test, and evaluate the new technology. For instance, the tradition radio expedition “pilot,” whose putative task was to be an intermediary between radio operators and the expedition, was rejected in favor of an online Help Desk, which enabled anyone to open a “ticket” that would be serviced by a support team. Another example is the Audio Log, which enabled automatic recording of messages from the expedition site, and automatic posting on a web page where anyone could listen to them.



Figure 3 – Testing the computers



Figure 4 – Testing the network

Other infotech developments that were implemented included real-time online graphic radio log display, remote radio operation, exotic radio modes including JT65, communications satellite terminals enabling direct internet connections (Inmarsat), Skype calling, social media (Facebook, Twitter), and GPS trackers.

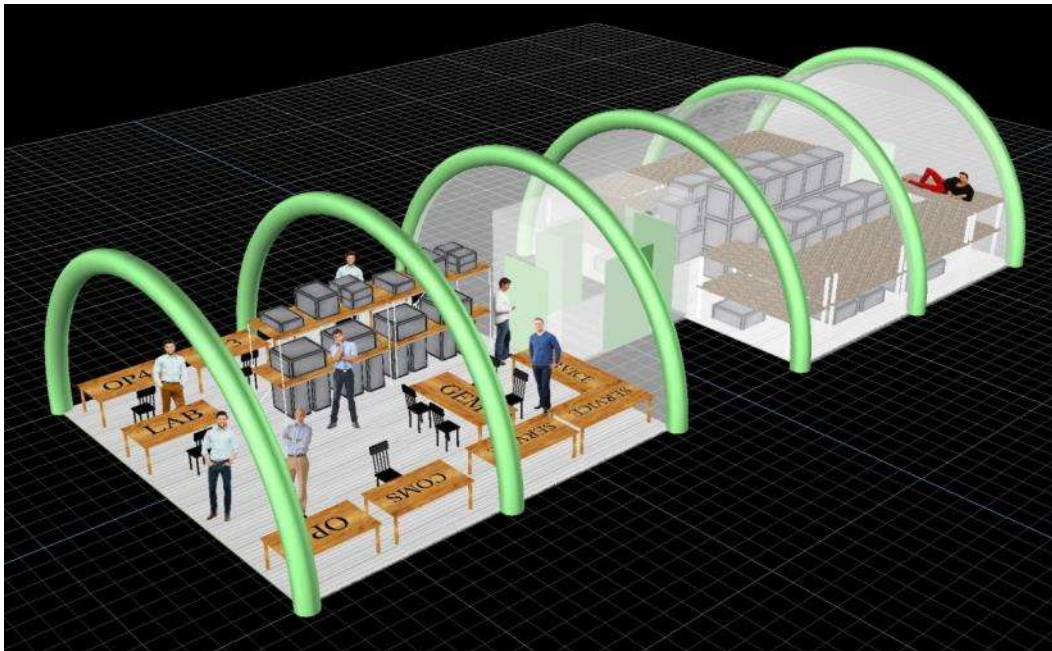


Figure 5 – Schematic layout of the AirBeam shelter •

Early in the planning an innovative shelter was adopted: the 20x20 ft². AirBeam, manufactured by HDT Global for military markets. The following diagram shows this shelter, which is erected in about 15 minutes using only an air compressor. Virtual reality software was used to optimize floorplans and to provide visualization of the campsite on Heard Island.

Documentation

Extensive documentation was necessary to carry out the project. Some of this is listed here.

IRS Nonprofit Organization

Cordell Expeditions is a 501(c)(3) nonprofit organization (authorizing document below, right). This means that, while CE must pay taxes on purchases, donations to CE are deductible by the donor.

Cordell Expeditions was granted a license for an amateur radio operation from the [Australian Communications and Media Authority](http://www.acma.gov.au) (ACMA).



Figure 6 – The nonprofit statement from the IRS



Figure 7 – The licence to operate radio using VKØEK ●

Policies and Participation Agreement

A CE Policies document (above, right) was updated from previous expeditions. It covers Definitions, Priorities, Property, Project Management, Responsibilities, Finances, and Eventualities.

The CE Participation Agreement (below, left) included Risk Acceptance, Adherence to the Policies Document, Personal Expenses, Costs, Emergency, Liability Waiver, and Comprehensive Binding to all its provisions. All members of the expedition signed this document as a condition of participation.



Figure 8 – Participation Agreement ●



Figure 9 - Policies ●

The Australian Antarctic Division (AAD) Permit

The application for a Visit Permit comprised numerous documents, all of which can be accessed [here](#). The images below give direct links to come of these documents.

Permit application documents



Figure 10 – Permit application cover letter

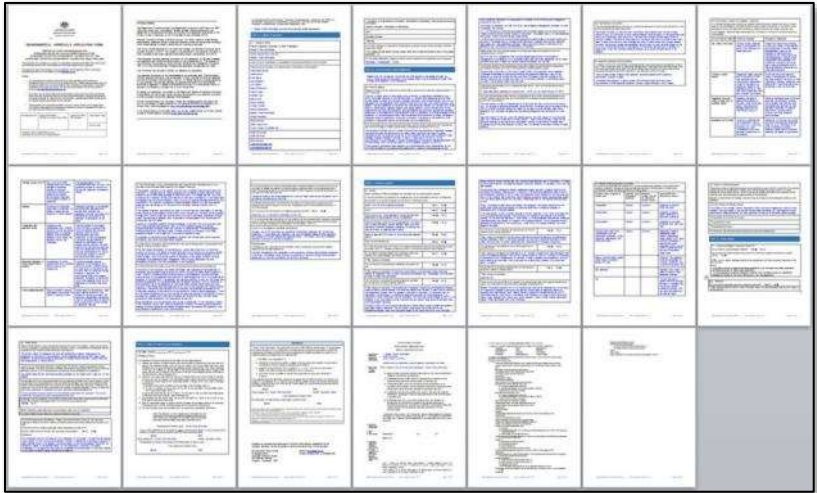


Figure 11 – Environmental Approvals Application



Figure 12 – Summary and analysis of the proposal

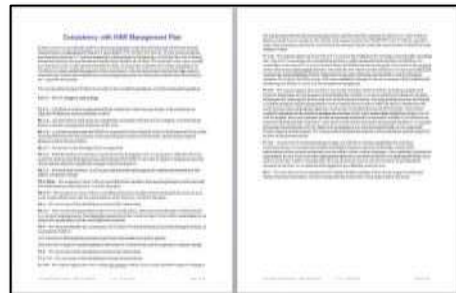


Figure 13 – Consistency with the HIMI Management Plan



Figure 14 – Public liability insurance (\$20M)



Figure 15 – Risk Management Plan

Proposals for collecting specimens

Detailed proposals for each of seven classes of specimen collection were submitted to the AAD. There was no editorial comment on the proposals (shown next 2 pages), and eventually they were approved.



Figure 16- Volcanism



Figure 17- Glaciers



Figure 18- Streams



Figure 19- Immigration



Figure 20- Colonizers

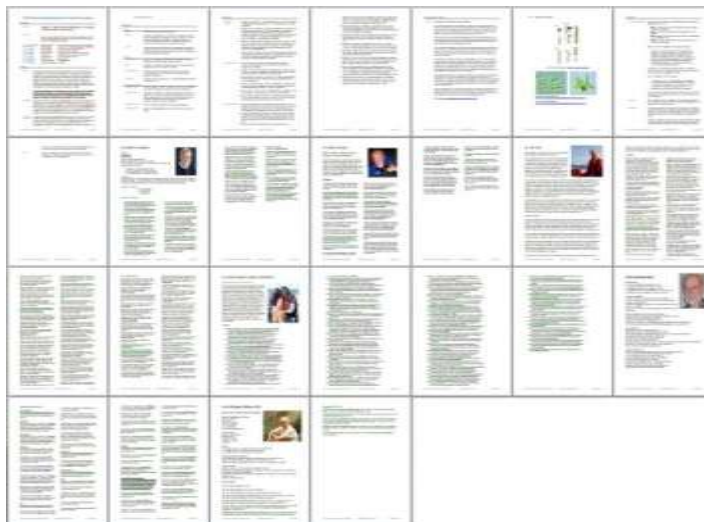


Figure 21- Diversity



Figure 22- Debris

The AAD Permit

The AAD issued the Visit Permit on 1 March 2016.



Figure 23 – The Visit Permit from the AAD ●

The Participants Handbook

A Handbook was prepared for the team members (above). It consisted of 450 pages in 8 sections:

- HEARD ISLAND
- THE EXPEDITION
- RADIO OPERATIONS
- SCIENCE OPERATIONS
- COMMUNICATIONS
- REFERENCE
- CHRONOLOGY
- MEDICAL.



Figure 24 – The Handbook

Outreach

Websites

Two websites were maintained for the entire course of the expedition: (1) The expedition website <http://www.heardisland.org>; and (2) The radio website <http://www.vk0ek.org>. Both of these continue to be active as of the writing of this document (November 2016).

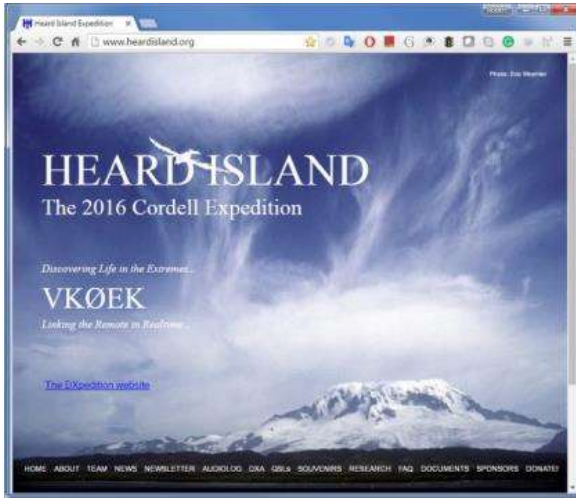


Figure 25 - <http://www.heardisland.org> ●



Figure 26 - <http://www.vk0ek.org> ●

Newsletters

Newsletters were sent electronically to a subscriber list. Altogether 14 Newsletters were distributed. The mailing list for the last one, which was a listing of all persons and organizations that contributed to the project, was sent to 7,181 persons.



Figure 27 – The Newsletters ●

The team

The onsite (traveling to the island) team consisted of 14 men, 10 from the United States, one from Switzerland, one from Ukraine, and two from Australia. The author of this document was Organizer/Expedition Leader. Co-organizer was Rich Holoch KY6R. The radio team leader was Dave Lloyd K3EL.



Figure 28 – The traveling team •



Figure 29 – The non-traveling team

The offsite team consisted of Rich Holoch KY6R, plus local teams in California, the U.S. East Coast, South Africa, and Western Australia.

Vessel

Finding transportation to Heard Island was far more difficult than in 1997. On that voyage, we simply paid passage on the French ship Marion Dufresne, which services the Kerguelen Islands. This time the MD was not available, and it proved extremely difficult to obtain a contract for a charter. Three ships (Fourcault, Agulhas II, Shokalskii) were solicited but their costs and requirements proved unworkable. In the summer of 2015, a contract was signed with the New Zealand vessel *Braveheart*, Nigel Jolly owner/skipper.



Figure 30 – MV Braveheart



Figure 31 – The Braveheart crew

Logistics

The equipment for the expedition was acquired and assembled in California and the East Coast. It was combined at the Virginia home of team member Ken Karr. The cargo was shipped in one 20-ft. container from Norfolk, VA, to Cape Town, South Africa, where it was put into warehouse storage pending arrival of the team around March 1. The team came from the U.S. (10 members), Switzerland and Ukraine (1 each), and Australia (2 members). Braveheart arrived in Cape Town from a cruise to South Georgia and South Sandwich Islands.



Figure 32 – A portion of the cargo in California



Figure 33 – The cargo in California ready for shipping



Figure 34 – Another portion of the cargo, in Virginia



Figure 35 – The cargo ready for shipping to Cape Town



Figure 36- Logistics of the cargo, team, and vessel, converging in Cape Town

Upon arrival of the team in Cape Town, the cargo was delivered to a warehouse on the dock. The warehouse itself was thoroughly washed and disinfected before the cargo arrived. The AirBeam shelters were inflated and professionally washed outside and inside. Following the prep of the cargo, inspectors acting on behalf of the AAD did a complete inspection, ultimately approving it for the expedition.



Figure 37 – Some of the cargo in the dock warehouse



Figure 38 – Camp equipment and supplies



Figure 39 – The two AirBeam tents on the dock



Figure 40 – Washing the inside of the AirBeam tents



Figure 41 – Washing the outside of the AirBeam tents



Figure 42 – Cargo inspection and approval

3. THE VOYAGE

Vessel track

Braveheart, carrying the 14 expedition team members and a crew of 6, departed Cape Town on 10 March, 2016, and was steered due south for three days to take advantage of more favorable wind and current conditions before heading East towards Heard Island. It arrived at Heard Island 22 March, left the island 11 April, and arrived Fremantle 21 April 2016.

The vessel track was observable in real time by two means: Global Positioning System (GPS below, left) and the Weak Signal Propagation Reporter (WSPR) network (below, right). The GPS tracker was arranged by team member Adam Brown. It utilizes the Iridium satellite system. It is called “InReach” and is offered by [Delorme](#). For the two months of the expedition, transmitted our location as often as every ten minutes and included unlimited text messaging.

The Weak Signal Propagation Reporter (WSPR) Network is a group of amateur radio operators using K1JT's MEPT_JT digital mode to probe radio frequency propagation conditions using very low power (QRP/QRpp) transmissions. The software is open source and the data collected are available to the public through [this site](#).

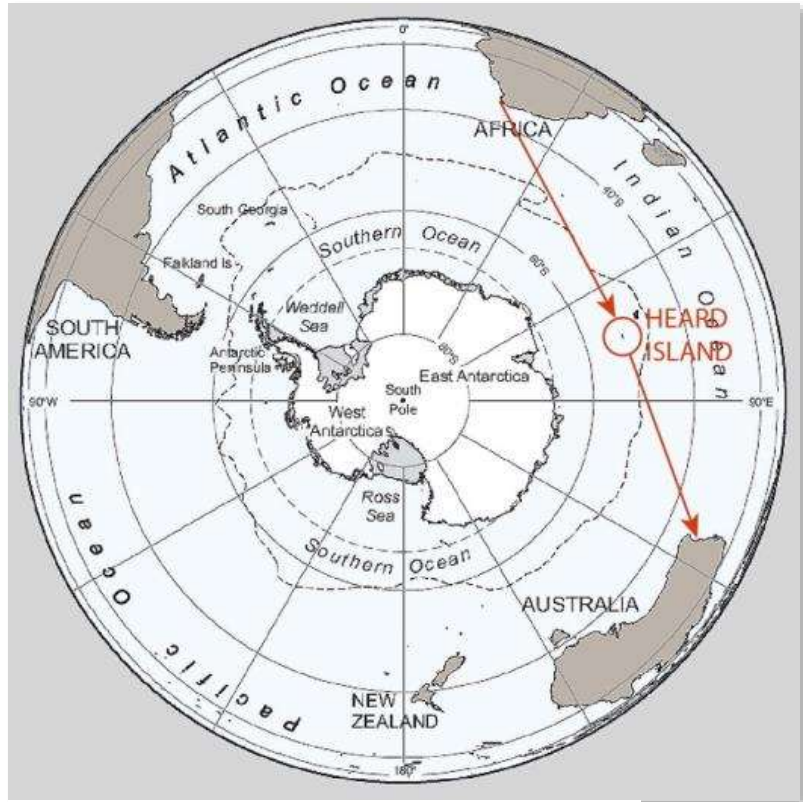


Figure 43 – Route of the voyage



Figure 44 – GPS tracker positions of the Braveheart



Figure 45 – WSPR network location of the Braveheart

Buoy deployment

During the voyage Adam Brown and the team deployed a series of buoys at pre-determined lines of latitude. There were two motivations for this: (1) Braveheart provided a platform of opportunity for contributing to the scientific programs that use free-drifting instrumented telemetering buoys to learn about the properties and movement of oceanic waters; and (2) The expected eastward drift of the buoys would give some information about the movement of floating and submerged objects in the vicinity of Heard Island.

NOAA drifters

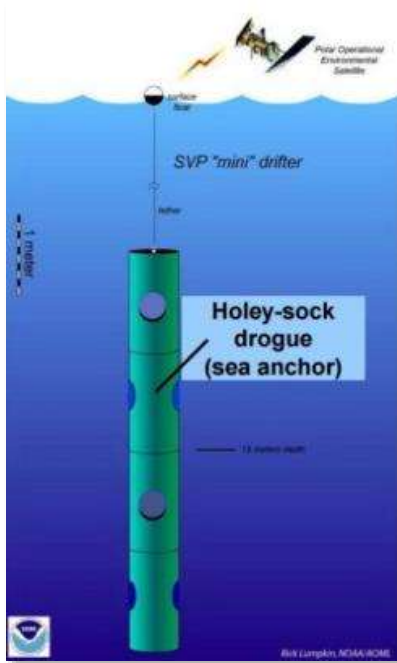


Figure 46 – The NOAA drifter buoy

The NOAA buoys are drifters: they move with the currents, telemetering environmental and instrumental data through a satellite to the NOAA database. Five of these drifters were deployed, all to the north and west of Heard Island. Some data from these buoys is shown in the section [ENVIRONMENTAL DATA](#).

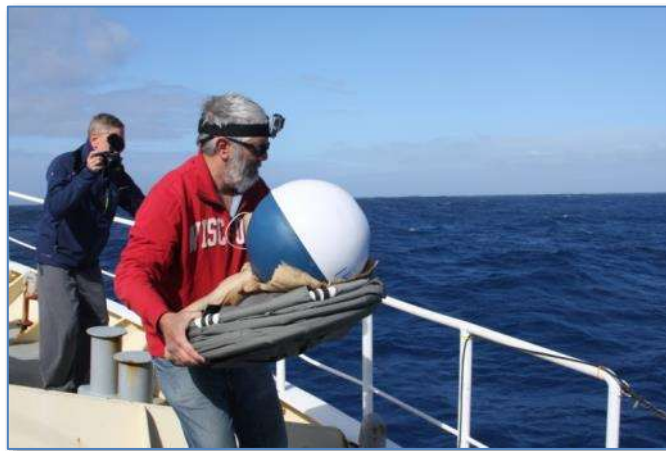


Figure 47 – Adam Brown deploying one of the buoys

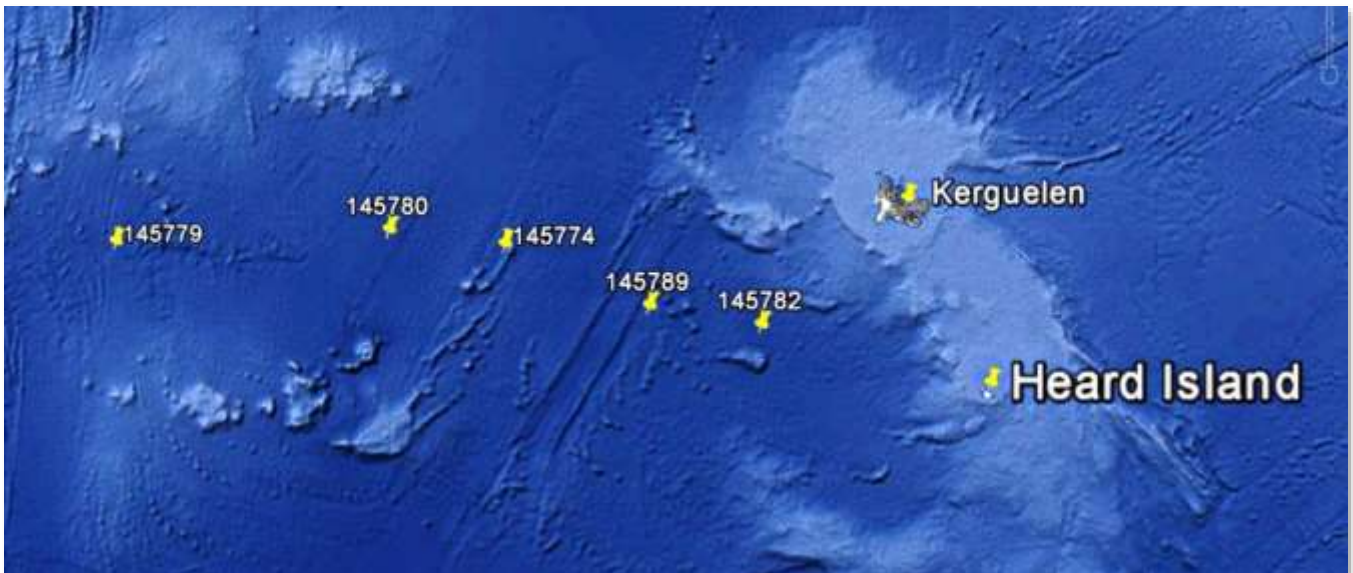


Figure 48 – Locations of the launches of the NOAA drifters

The buoys were of two types: (1) Drifters, provided by the National Oceanic and Atmospheric Administration (NOAA), and (2) Divers, provided by the Woods Hole Oceanographic Institute (WHOI). The NOAA buoys are shown on this page, the WHOI buoys on the next page. The buoys are also deployed by simply throwing them in the ocean. The maps show the locations of the various buoys. The devices automatically activate and immediately telemeter their basic data (“call home”). We could see this happen with each buoy shortly after it was deployed.

WHOI ARGO diving buoys

The WHOI buoys are divers: they descend to about 1000m depth, drift for 9 days, then descend to 2000m depth, recording environmental data, then resurface and telemeter the data to the WHOI database. Five of the ARGO buoys were deployed during the voyage. Data from these instruments are presented in the section [ENVIRONMENTAL DATA](#). One of the buoys made a direct approach to Kerguelen Island, but then skirted around it to the south and returned to its original trajectory. We hypothesize that much the same could occur at Heard Island, but we had no buoy data to show this.

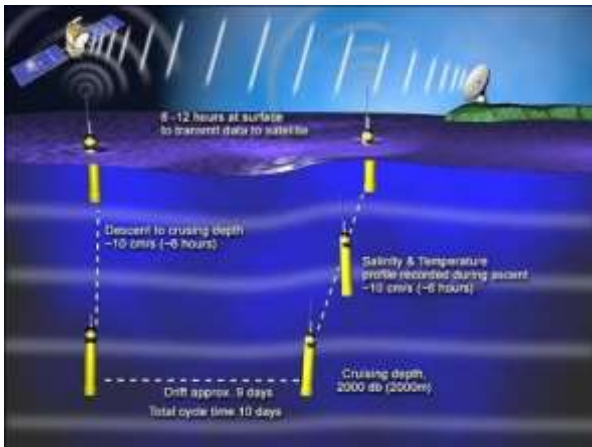


Figure 49 – The WHOI diving buoy



Figure 50 – Deploying one of the buoys

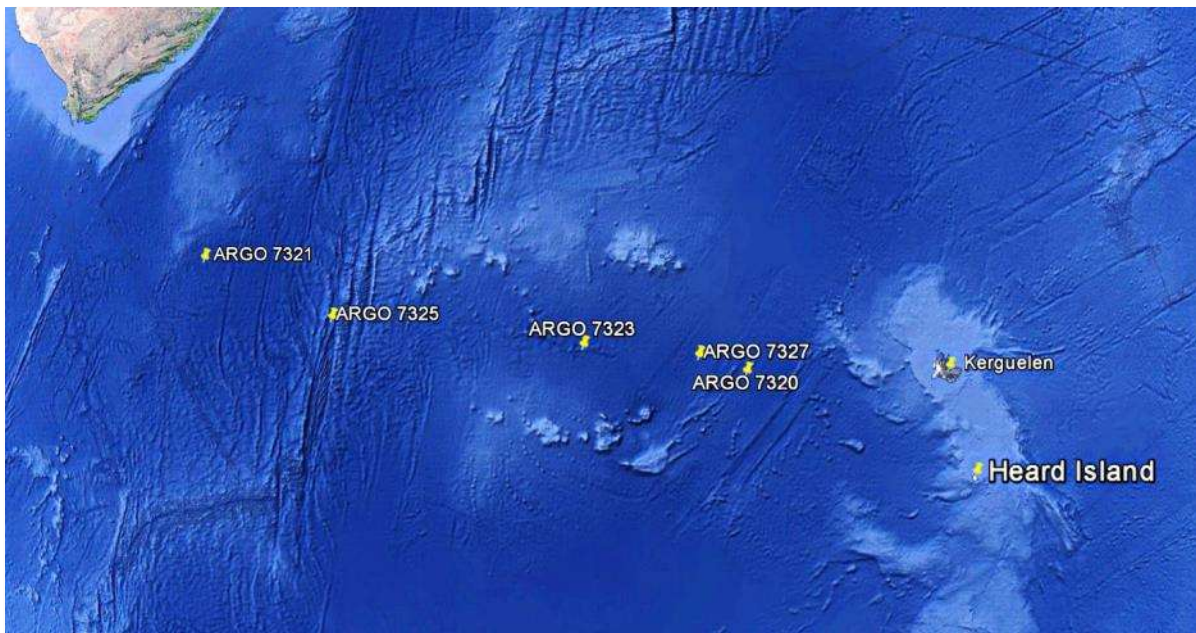


Figure 51 – Locations of the launches of the WHOI diving buoys

Onboard

The 12-day voyage was mostly uneventful. The weather was relatively mild, and the sea was much calmer than expected. Activities included mostly resting, eating and working maritime mobile radio.



Figure 52 – The entire team. From left to right: Cheshire, Lloyd, Thompson, Farnsworth, Nascimento, Mitchell, Brown, Blattler, Karr, Colletto, Ivliev, Marshall, Belton, Schmiieder. Although the seating was random, apparently all the clean-shaven men sat together! ●



Figure 53 – Taking a meal on the Braveheart



Figure 54 – Operating radio maritime mobile

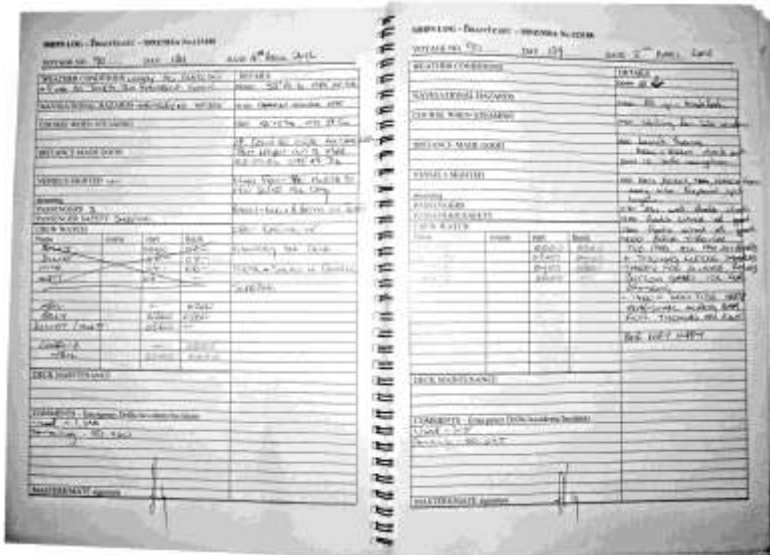


Figure 55 – A page in the Braveheart ship's log

4. OPERATIONS ON THE ISLAND

Overview

Upon approaching Heard Island, Braveheart proceeded directly to a safe anchorage in Atlas Roads. A short reconnaissance landing was made at Atlas Cove later that afternoon in order to raise the Australian flag and search for a suitable location for the campsite. During the next three weeks, Braveheart remained at anchor in Atlas Roads, except for a three day excursion to the waters off Stephenson Lagoon to drop off and support a landing party there.

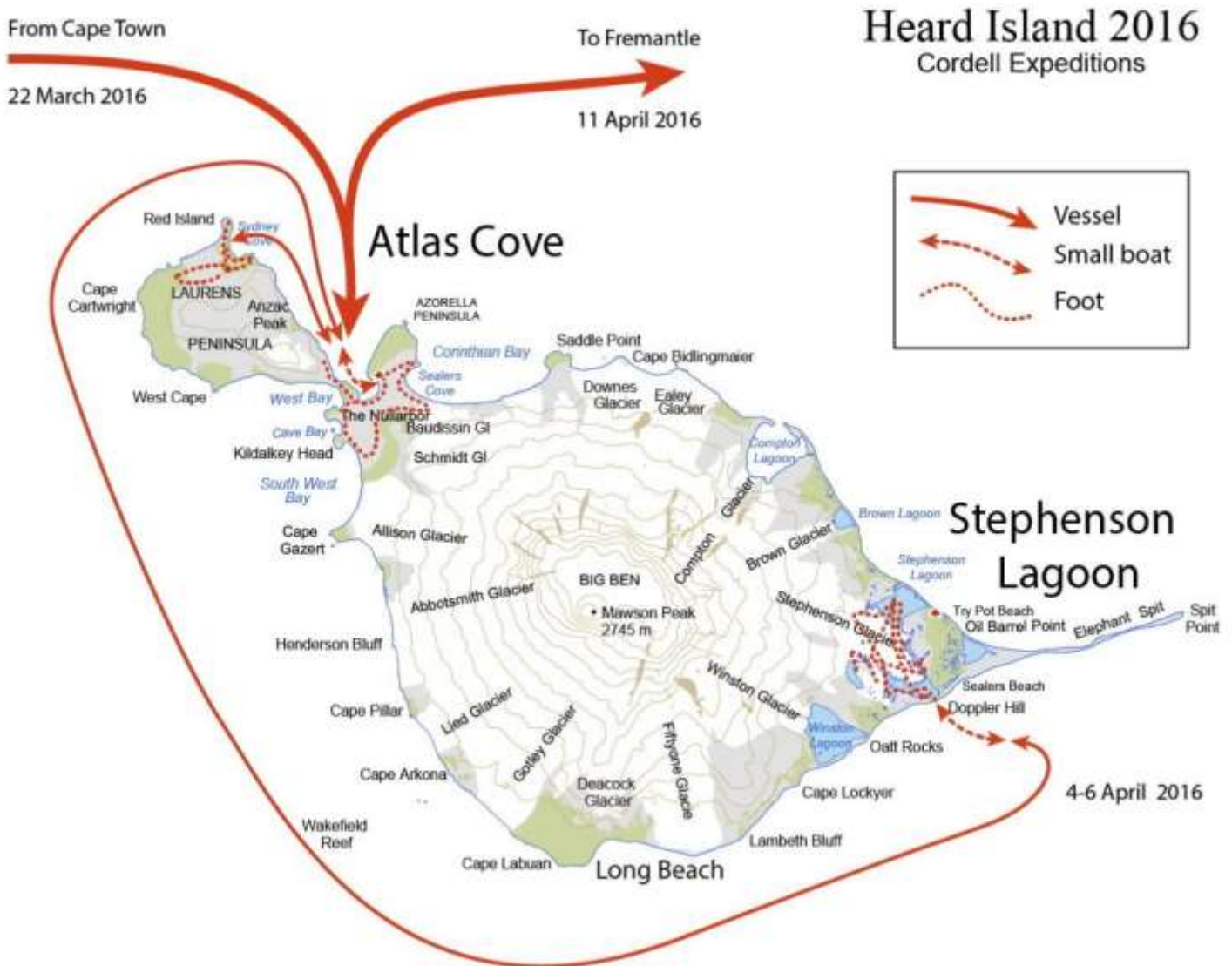


Figure 56 – The track of the expedition during the 2016 visit to Heard Island. The Stephenson Lagoon excursion was 3-6 April 2016 •

Atlas Cove

The principal location for expedition operations was Atlas Cove., shown here in a 2014 satellite image. (Google Earth). Personnel were landed at Wharf Point, about 450m from the campsite. Cargo was landed at the beach and moved by ATV/wagon 275m to the campsite.



Figure 57 – The location of the 2016 campsite at Atlas Cove

The main campsite was selected to be near the edge of the Nullarbor and away from the ANARE ruins and the AAD refuge shelters. The apple shelter was used to house the latrine.



Figure 58 – Locations of various facilities, historical and recent

Landing and transportation

Personnel landed at Wharf Point to avoid getting wet in the surf. The first team member to land was Australian Alan Cheshire, who raised the Australian flag. Cargo was landed on the Atlas Cove beach.



Figure 59 – Landing at Wharf Point



Figure 60 – The Australian flag is raised upon landing.



Figure 61 – Landing cargo at the beach



Figure 62 – The ATV is unloaded at the beach.



Figure 63 – The ATV/wagon is used for moving the cargo.



Figure 64 – The campsite is about 2m above the Nullarbor.

Setup

The site selected for the camp was a nearly level rectangle about 10m wide and 20m long. It needed minimal clearing of loose rocks and raking of the dirt to provide a suitable ground for the AirBeam shelters. It took about 2 hours to lay out the shelters, stake them securely into the ground, and inflate them with the air compressors. Sandbags were used around the periphery to prevent wind lifting and/or leaking into the tents.



Figure 65 – Clearing the site selected for the shelters



Figure 66 – Preparation of the ground for the tents



Figure 67 – Deploying the first of two AirBeam shelters



Figure 68 – Inflating the first of two AirBeam shelters



Figure 69 –The second AirBeam is being inflated.



Figure 70 –The shelters are complete.

Campsite

The completed campsite comprised the operations and dormitory tents, and a staging area out the back door.



Figure 71 – The completed shelters (operations, dorm)



Figure 72 – The completed campsite



Figure 73 – The service yard and the main entry door



Figure 74– The campsite was in and around the lava.



Figure 75 – The flags of the team: Australia, USA, Ukraine, Switzerland, & New Zealand ●

Power

The generators were kept inside plastic trunks to prevent fuel spills.

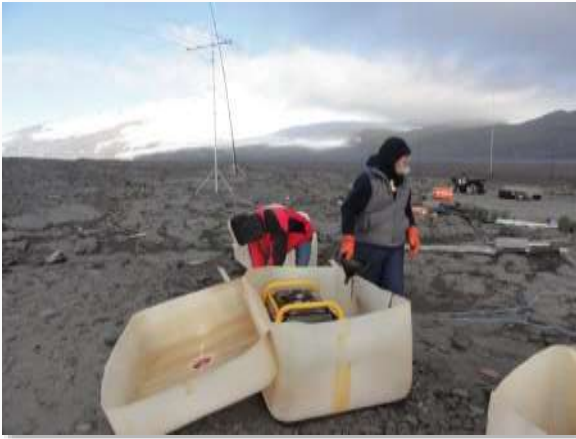


Figure 76 – The generators were contained.



Figure 77 – The container was an empty diesel fuel box.

Sanitation

The AAD apple shelter, about 100m from the camp, was used to house the latrine.



Figure 78 – The AAD refuge shelters (rear) and the apple



Figure 79 – The apple shelter housed the latrine.

Supplies

The ATV/wagon was used to shuttle the supplies between the beach and the campsite.



Figure 80 – The ATV was able to operate on flooded terrain.



Figure 81 – Fuel and water were delivered in jerry cans.

Antennas

For the radio operation, about a dozen antennas were erected around the campsite, including Yagi, vertical, and 4-square vertical arrays. The antennas were coupled to patch panels that allowed any of the radios to use any of the antennas. The antennas on the Nullarbor worked even when they were flooded by wind-driven seawater.

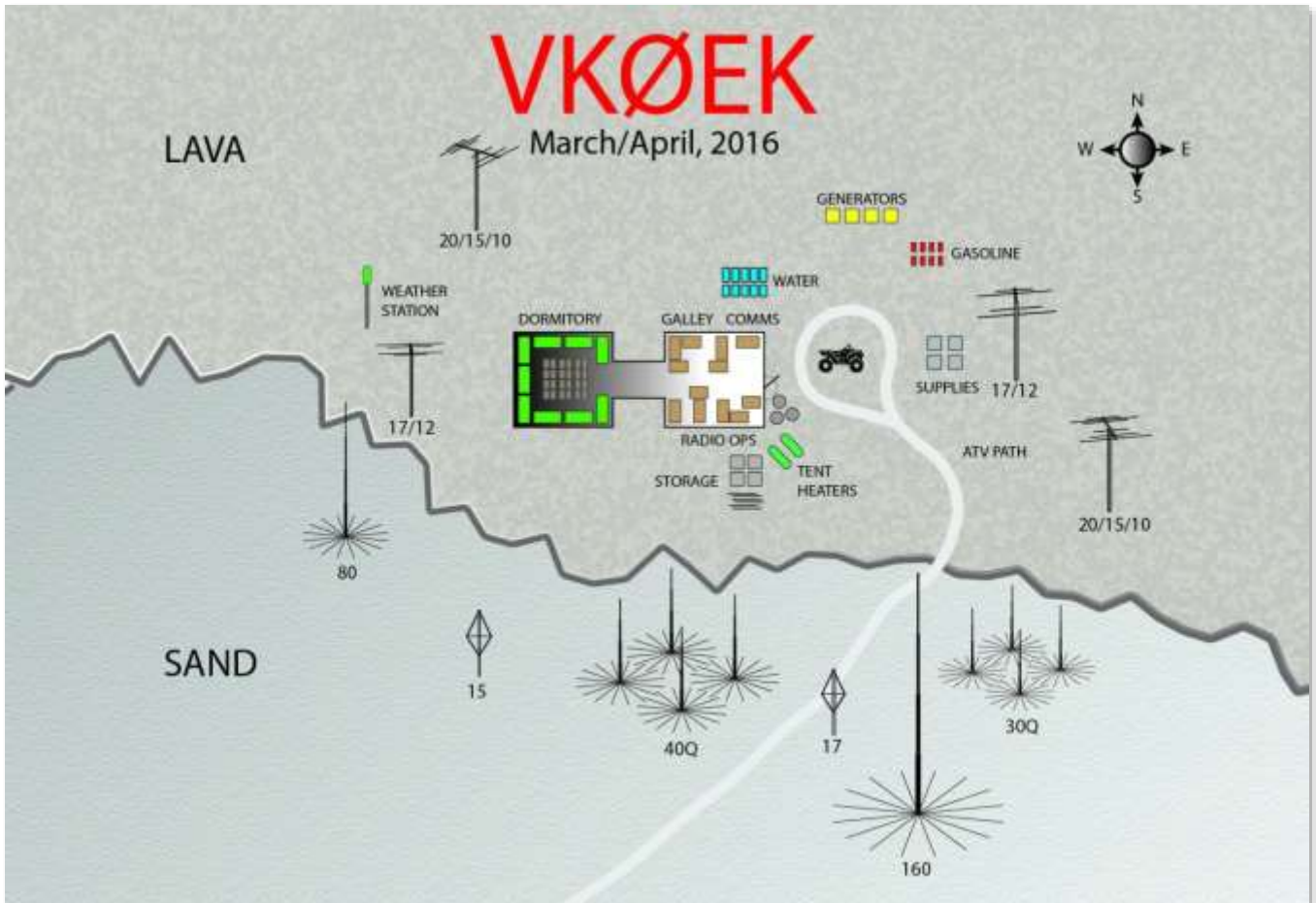


Figure 82 - Campsite layout



Figure 83 – The antenna array around the campsite, looking NW •



Figure 84 – The completed campsite, at the edge of the Nullarbor and facing Big Ben ●



Figure 85 – View of the campsite with the AAD shelters, the ANARE ruins, and Laurens Peninsula in the background. ●

Operations shelter

Operations: (right) Radio; (left rear) Communications; (left foreground) Galley



Figure 86 – The operations shelter. Radio operations at right, communications at far left, galley near left •

Radio operations

All radio stations had the same core equipment: radio transceiver, amplifier, and computer. Additional equipment included personal Morse keys, monitoring meters, notebooks, and cabling. Eight stations were implemented, but because of propagation limitations, typically only 5 or 6 stations would be operating at a time. The team took 4 hour shifts, 3 shifts per day. The log shows that about 75% of the contacts were made using CW (Morse code).



Figure 88 – Radio operations •



Figure 87 – One of the eight stations

Remote radio operations

During the preparation for the radio operation, Mike Coffey KJ4Z developed the capability to operate a station on Heard Island from a remote location. While remote radio control is now becoming common, to our knowledge no major DXpedition has attempted it. The system is shown in the figure below:

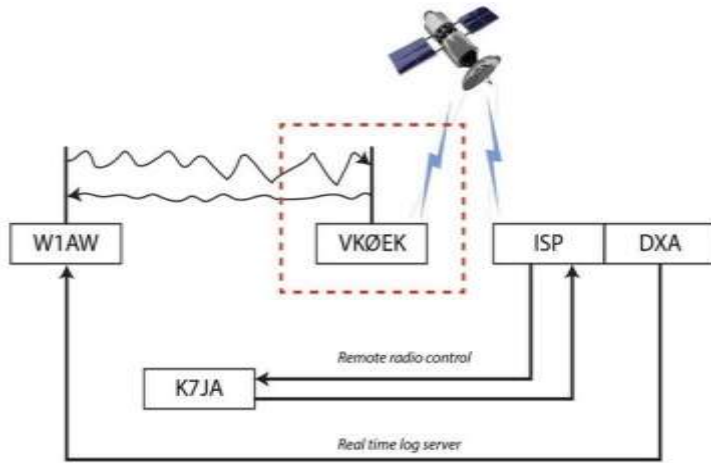


Figure 89 - The scheme for operating the radio remotely



Figure 90 – The Elecraft K3/0 radio for remote operation

In a hypothetical case, a DXer at W1AW makes a contact with VKØEK on Heard Island. Normally, this contact would be handled by the operator on the island. But in remote operation, the radio itself uploads the incoming signal through the satellite to a server (ISP). A DXer located in Southern California, in this case Chip Margelli K7JA, receives the incoming signal, which is routed directly into his remote-capable receiver (Elecraft K3/0). The Elecraft information about its capability includes the following:

The K3/0-Mini, full-size K3/0 or a standard K3 in ‘terminal mode’, provides a unique real time remote control experience for operating a K3 located in the next room, or across the country. When paired with the RemoteRig devices this K3 Remote system can connect your local K3 or K3/0 to a remote K3 over the internet, including transmit and receive audio, without the need or complexity of setting up computers on each end. The K3 Remote system provides a provides a “*real radio*” feel with immediate control feedback and very fast response times. The K3/0 uses its internal speaker and front headphone jack for receive audio, and its front microphone connector for your mic input. The result is a faithful recreation of your remote K3 on the local K3 that is hard to distinguish from operating the actual radio.

With direct support from Elecraft, Mike put this system together, and it was used to log about 40 QSOs during the VKØEK operation as a demonstration. The DXers who worked this station during the VKØEK operation were unaware that the actual operator was in Southern California. However, the QSOs so logged are legal for the DXCC program.

It was very satisfying to see that the latency involved in the satellite-remote link was less than 1 second, *i.e.*, not noticeable to either operator.

Communications

Reliable broadband Internet connection was provided via three INMARSAT BGAN terminals', one of which was dedicated to the radio operation for updating the radio logs in quasi-real time.



Figure 91 – The Inmarsat BGAN satellite terminals



Figure 92 – The communications corner

Galley

The galley was used to store and prepare food. It was run by team member Alan Cheshire.



Figure 93 – The galley



Figure 94 – The galley

Dormitory shelter

The second AirBeam shelter was used as a dormitory, accessed through the hallway.



Figure 95 – The hallway between the shelters



Figure 96 – The dormitory shelter

Specimens

As part of the Visit Permit application, Cordell Expeditions prepared seven proposals for collecting specimens of rocks, soil & sediment, water, and debris. These documents are available as supplements to this report. On Heard Island, specimens were collected in conformance with these proposals, principally by team members Fred Belton and Gavin Marshall. The specimens were individually packaged and documented. On the return voyage they were fixed with ETOH and triple bagged.



Figure 97 – The first water and sediment specimens



Figure 98 – Each specimen was bagged and keyed.



Figure 99 – Collecting a rock from a glacial fragment



Figure 100 – Part of the specimen collection



Figure 101 – One of the water sample bottles



Figure 102 – The collection of water sample bottles

Weather

Charts

Braveheart kept a close watch on the weather, finding it necessary to change the anchorage, schedule, or position in response to incoming fronts. Predictions were also valuable to the team for planning of operations.

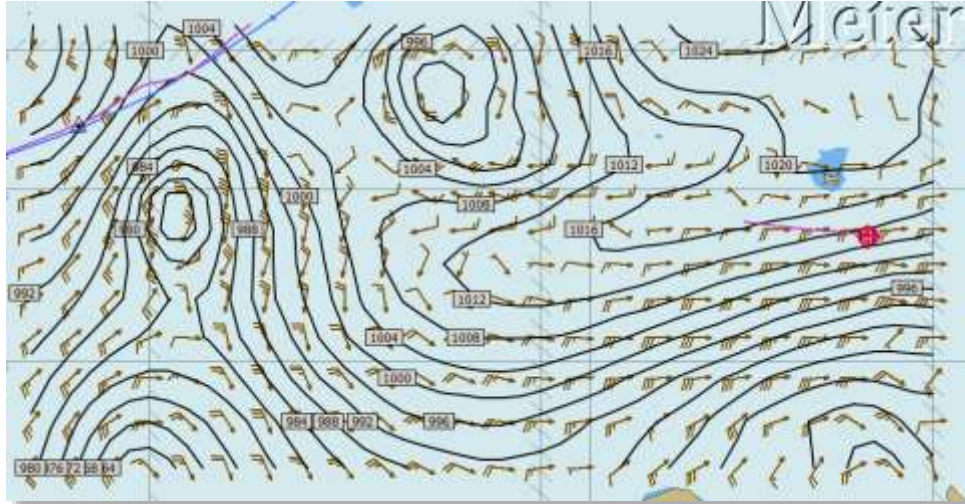


Figure 103 – Synoptic charts were provided by the Braveheart crew

Weather station

During the stay at Atlas Cove the team deployed a Kestrel 5500 recording weather station. It was located 50m due west of the campsite in order to minimize false readings.

The meter could be monitored from inside the tents by anyone who has installed the Kestrel app on their iOS or Android device. We also had a dongle that worked with a PC running Windows 7.

The Kestrel is weather-proof and can record accurate wind speeds up to 85 MPH. It can store up to 10,000 sets of time stamped data taken at predetermined intervals. During the 3 week period we recorded the weather conditions every 5 minutes.



Figure 105 – The Kestrel weather station



Figure 104 – The station deployed at Atlas Cove campsite

Temperature-illuminance logging



Figure 106 – One of the HOBO probes

Dr. Steve Smith, Managing Director of OceanEarth, Inc., provided 16 Onset HOBO data loggers to the Heard Island Expedition, to monitor the temperature and light intensity. These units record the measurements in programmable intervals. We deployed 6 of these units, set to record once per minute over the 3-week stay. At the end of the stay, these units were recovered and the data read into an Excel file, enabling analysis and plotting .



Figure 107 – One of the HOBO probes on the Nullarbor



Figure 108 – One of the HOBO probes at Atlas Cove

Gigapan imaging

Team member Bill Mitchell arranged for the loan of a Gigapan camera mount to the expedition by Prof. Callan Bentley, Assistant Professor of Geology at the Northern Virginia Community College. The robotic mount enables a camera to be scanned over a wide field, capturing a set of high-resolution images that are stitched together by software to make a single, very large, very high-resolution image. Mitchell used the mount with his camera to obtain numerous images of the Heard Island environment.



Figure 109 – The Gigapan Epic camera mount



Figure 110- Using the Gigapan camera mount (not Heard Island)

Drone flights

Gavin Marshall and Robert Schmieder each brought with them a drone (Unmanned Aerial Vehicle, UAV), with the intention of using them to document the colonies of penguins, seals, seabirds, ponds, the coastline, and plants. Unfortunately, the Permit, which arrived long after our equipment was shipped to Cape Town for the expedition, imposed severe restrictions, including:

- (ii) A UAV must not be operated over, or landed within, the Heritage Zone or Restricted Zone.
- (vi) Controllers must not operate a UAV within 250 metres of wildlife or concentrations of vegetation.
- (vii) Controllers must immediately stop the operation of a UAV if it causes any modification to wildlife behaviour.
- (ix) Controllers must maintain a continuous visual line of sight with their UAV at all times.
- (x) Controllers must not operate a UAV at an altitude greater than 120 metres.
- (xi) Controllers must not operate a UAV within 30 metres of a vehicle, vessel or person.

These restrictions effectively precluded the operation of the drones. The only operation was a test flight on the Nullarbor, which did yield a short segment of video of the campsite.



Figure 111 – One of two drones brought by the expedition



Figure 112 – Gavin Marshall preparing to fly the drone

AAD shelters

The AAD refuge shelters were not used by the 2016 expedition team, due to the prohibition in the Permit.



Figure 113 – The AAD refuge shelters, just east of the ANARE ruins



Figure 114 - The dining shelter



Figure 115 – Emergency food cache left by the expedition



Figure 117 - The galley door



Figure 116 - Repairing the door

(Above, left) The dining shelter was relatively clean, but there were few provisions. Some tools had been left by previous visitors.

(Above, right) The 2016 expedition left two buckets of emergency rations in the galley shelter.

(Left) The doors on the shelters were found to be rust-frozen, so Australian team member Alan Cheshire repaired them. This involved disassembly, cleaning and lubrication of the parts, and reassembly.

Visitor log

In accordance with the Visit Permit, the Expedition Leader entered the galley shelter to sign the visitor log. The log was found to be in two binders, dating back to 1953.



Figure 119 – The visitor log on Heard Island

Entries in the Log were made for the present (2016) visit, and also for the 1997 visit. The latter expedition (VKØIR) was also organized and led by the author, but the Log was not known and therefore no entry was made at that time. (Right) The entry for the 1997 Cordell Expedition.

(Below) The entry for the 2016 Cordell Expedition. It was signed by all the team members.

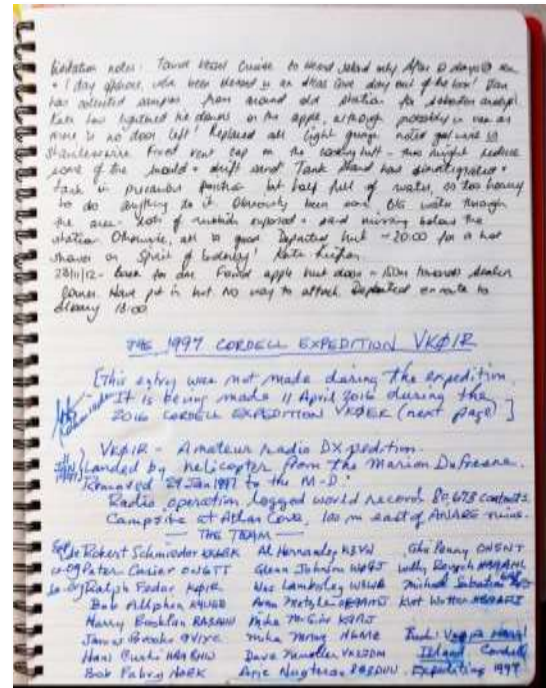


Figure 118 – The CE entry for 1997

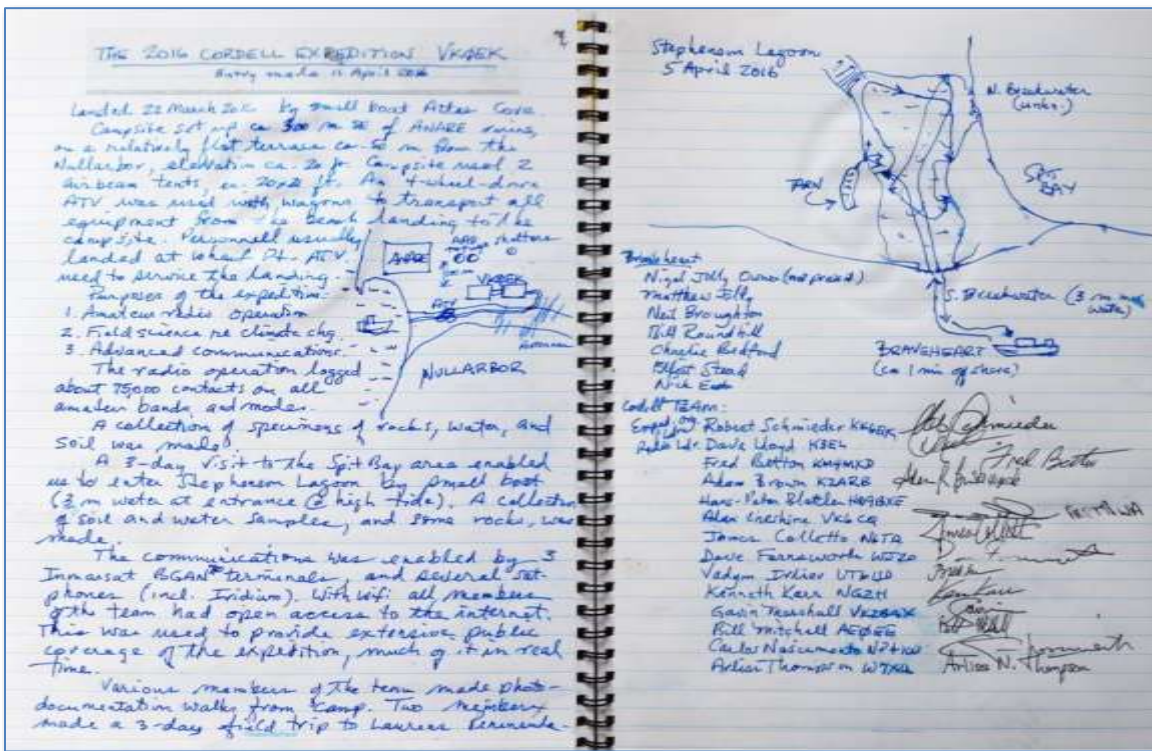


Figure 120 – The Cordell Expeditions entry for 2016 ●

Close of operations

Operations were closed on 11 April 2016. The skipper of Braveheart informed the team that the entire departure operation must be done that day, due to the approach of a severe weather front. Failure to depart by that evening probably would mean delay of a week or more, as winter weather was arriving. There was just barely time to take the group picture when a very cold hail began to fall, covering the ground.



Figure 121 – The Cordell Expeditions team at the conclusion of the operation •



Figure 122 – Hail on the ground at departure time



Figure 123– Hail on the ground at departure time

Takedown and departure

The AirBeam shelters came down quickly, aided by a vacuum machine. They were rolled up and placed in their carrying bags to await transportation to the beach. The area where the shelters had been was returned to approximately its original condition by moving the loose rocks back into the area. Several members of the team walked the campsite area to make a detailed inspection, determining that it was completely clean—not a single foreign item, no matter how small, was left on the site. The team then walked to Wharf Point to await pickup. The entire operation was completed in 9 hours. Because of the large amount of cargo, some members of the team had to wait up to 4 hours to leave the island.



Figure 124 – The AirBeam is deflated using a vacuum



Figure 125 – The deflated AirBeam is rolled for bagging



Figure 126 – The team shows off a clean campsite



Figure 127 – The cargo is transported to the beach



Figure 128 – The team walks to Wharf Point to await pickup



Figure 129 – The last of the cargo is loaded for the Braveheart

Laurens Peninsula

On 30 March 2016 Fred Belton and Gavin Marshall were taken by motor launch to Sydney Cove, on the northern tip of Laurens Peninsula, for a 4-day exploratory stay. They found the apple shelter useable, although occupied by a large number of spiders. They attempted to ascend Mt. Dixon to obtain rock specimens, but the harsh weather and nearly unconsolidated scree made this impossible. They did photo-document the area at lower elevation. Details of their tracks as they explored the area are included in the section on SPECIMENS.



Figure 130 – The track of the landing craft



Figure 131 – The track of the landing craft



Figure 132 – The apple shelter with a view of Red Island



Figure 133 – The apple shelter



Figure 134 – Inside the apple shelter



Figure 135 – A note on the inside of the shelter

Stephenson Lagoon

Overview

During 4-6 April 2016, Braveheart made an excursion to the vicinity of Stephenson Lagoon, near Spit Bay coastline. The following figures show the track of the vessel, and the track of the motor launch that enabled Robert Schmieder, Gavin Marshall, and Fred Belton to enter and explore the lagoon.

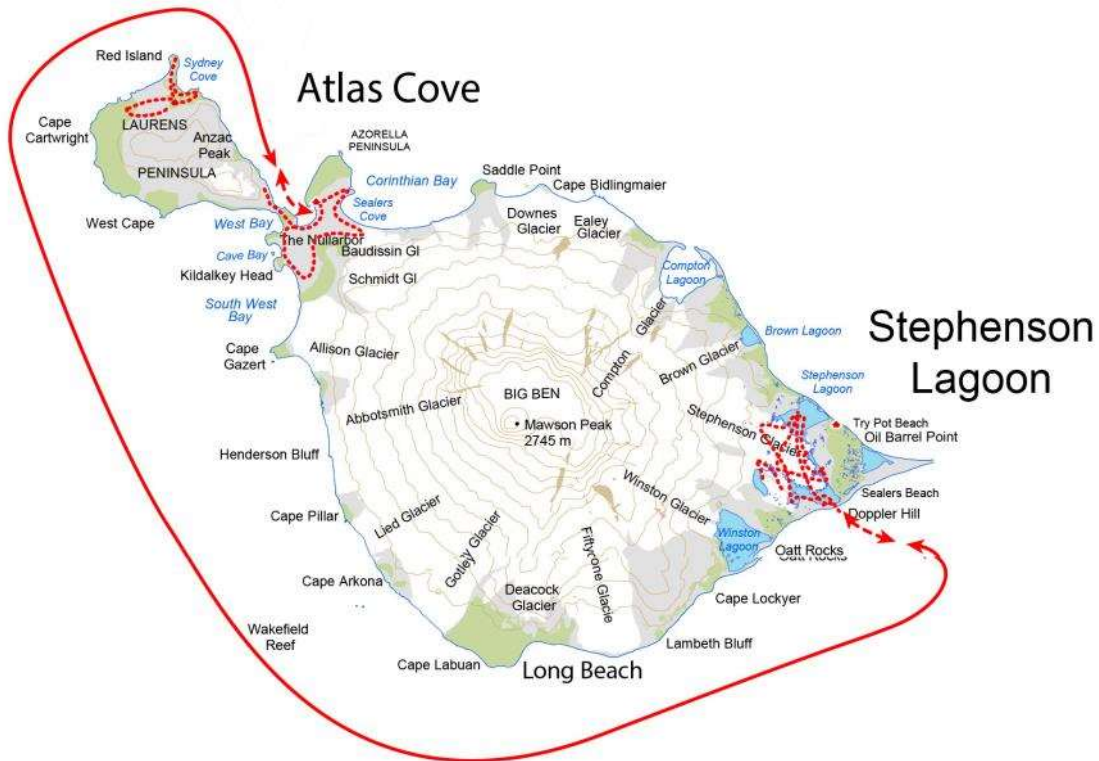


Figure 136 – Track of the Beaveheart during the Stephenson Lagoon excursion



Figure 137 – Track of the landing party inside the lagoon (cf., additional charts below)

Entry into the lagoon

The excursion was made overnight, arriving in the morning, but unfortunately the sea state was too high, and no attempt was made to enter the lagoon. With clear weather, however, the team was able to take many photographs of the southern entrance to the lagoon. Entry was made the following morning.



Figure 138 – The author showing the entrance to Stephenson Lagoon about 2.5 km away



Figure 139 – The entrance. The former solid breakwater was almost completely eroded away. ●

The lagoon

The weather inside the lagoon was noticeably calmer and warmer than outside.



Figure 140 – The service boat on the Stephenson Lagoon

West shore

The first stop was the western shore. All three team members disembarked and began to explore and document the area. Belton and Marshall went up the slope immediately to the west, to reach the tarn, while Schmieder walked north along the shoreline to reach the outlet of the subsurface stream that was discovered in the satellite images.



Figure 141 – The first landing on the west shore

Tarn

Belton and Marshall documented the geo- and glacio-morphology at the tarn, and collected rock, plant, and water specimens.



Figure 142 – Preparing to document the tarn to the west of the lagoon

Stephenson Glacier

Inspecting the terminus of the Stephenson Glacier. The team was able to approach within about 50m, but it was felt that lingering so near might be risky should the glacier calve.



Figure 143 – Exploring the terminus of the Stephenson Glacier

East shore

Schmieder took the service boat and Braveheart crew to the east shore and collected specimens in two locations.



Figure 144 – Collecting specimens on the east shore

Bottom samples

The team was able to obtain a sample of the bottom gravel near the western shore, at a depth of about 10 m. The depth sounder showed a maximum observed depth in the lagoon greater than 100m.



Figure 145 – Collecting a sample of the bottom of the lagoon

Ice

The lagoon had very little floating ice. This melt-rounded “bergy bit” was examined and chunks were brought onboard for samples.



Figure 146 – An ice formation floating in the lagoon

North shore

The full team landed at the north shore (about 4.5 km from the south breakwater), in order to document the north breakwater and make further collections of specimens.



Figure 147 – Collecting specimens on the north shore

South shore

Marshall made an extensive photo-documentation of the penguin/seal colony at the south entrance.

The original image was poor quality, so this image has been processed and converted to monochrome with color highlight of Gavin documenting the elephant seal group.



Figure 148 – Photographing the seal/penguin colony on the south shore

Specimen collection

Schmieder made collections of sediment and water, and a few organic materials, which probably were decaying plants. All the specimens were returned to him in California for analysis, and some are described elsewhere in this document.



Figure 149 – Part of the collection of specimens from the east shore of the lagoon

Exiting the lagoon

At the southern entrance the breakwater is almost totally eroded away, leaving a few wash rocks (below, left) and large breakers (below, right). Exiting the lagoon proved difficult as it was necessary to negotiate breaking waves of up to 3m. Because of the shallow rocky bottom, entry into the lagoon through this passage is recommended only at high tide, with a powerful and sturdy boat.



Figure 150 – The west side of the south entrance. Clearly, the original breakwater is almost totally reduced to wash rocks.

5. FIELD RESEARCH ON THE ISLAND

Overview

The areas visited by 2016 Cordell Expedition team members are indicated on the following satellite image (Google Earth, 2014).

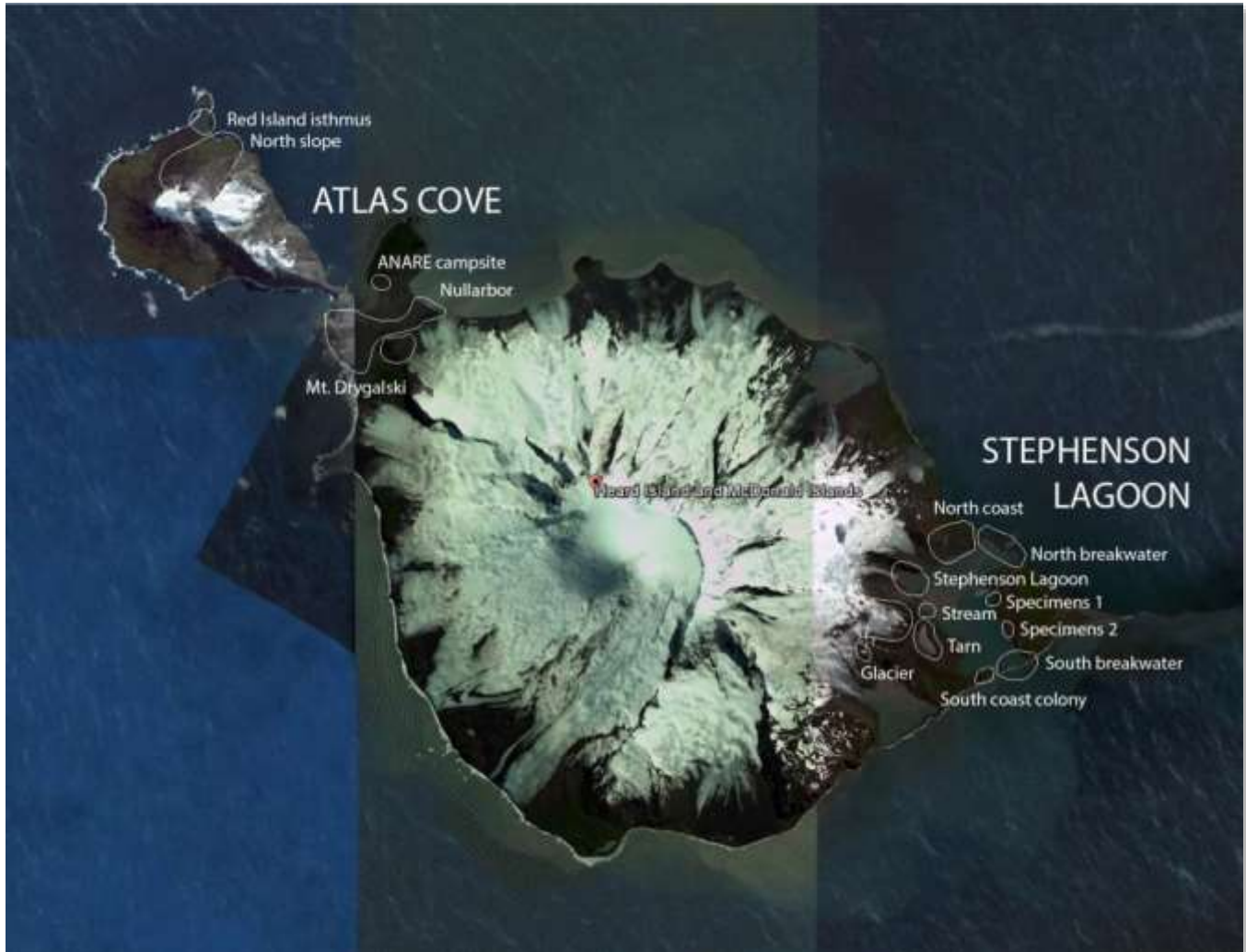


Figure 151 – Satellite image (Google Earth 2014) showing the operations during the visit to Heard Island 2016

The field research included the following activities:

- Photodocumentation
- Specimen collection
- Instrumentation

We consider the photographs to be data rather than pictures. While some of the images are striking, it is their content, especially when compared with historical photographs of the same area that is the object of the field research. The expedition team returned with more than 25,000 photographs of Heard Island and the ancillary parts of the expedition; eventually the complete archive will be made available to interested parties. In this section we present just a few representative images, and we provide only minimal (or no) comment on the individual images. The specimen collection is described in the next section.

Atlas Cove

Wide views

The photographs show wide-angle views of selected areas in Atlas Cove area. The images are typically 10,000px x 2500px, about 3MB JPG. These eight images are linked to online archives, to enable the full-resolution pictures to be downloaded. To download <ctrl>-click on the image. Links for these pictures are also provided on the main website page http://www.heardisland.org/HD_pages/HD_news.html.



Figure 152 – Southwest Bay, Kildalkey Head, West Bay, Laurens Peninsula, Atlas Cove, Azorella Peninsula, Nullarbor, Corinthian Bay ●



Figure 153 – Nullarbor with campsite and Laurens Peninsula ●



Figure 154 – Campsite facing flooded Nullarbor ●



Figure 155 – The Nullarbor ●



Figure 156 – Campsite facing flooded Nullarbor ●



Figure 157 – Southwest Bay ●



Figure 158 – Laurens Peninsula and Azorella Peninsula, with Mt. Drygalski in the foreground ●



Figure 159 – Corinthian Bay, Azorella Peninsula, Laurens Peninsula ●

The shoreline



Figure 160 – Atlas Cove, with Laurens Peninsula at left. The campsite is in the distance at right. ●



Figure 161 – The campsite in the distance



Figure 162 – Atlas Cove, Big Ben in the distance



Figure 163 – Seals and seabirds at Wharf Point



Figure 164 – Penguins and seals on Walrus Beach

Big Ben

Big Ben dominated the view from the campsite, although on most days clouds obscured or completely hid it. During the two days of landing and two days of departing, the weather was clear, and many high-resolution photographs were obtained.



Figure 165 – Big Ben seen from behind the campsite. The prominent vent edifice is seen on the right shoulder. ●



Figure 166 – Big Ben and Mt. Drygalski across the Nullarbor



Figure 167 – Big Ben seen from the campsite

Mawson Peak appears on the western shoulder. It has grown several hundred feet since the 1997 expedition. It was actively smoking during both the 1997 and 2016 expeditions.



Figure 168 – Mawson Peak seen from Atlas Roads (the entrance to Atlas Cove)



Figure 169 – Mawson Peak seen from the campsite, slightly east of the ANARE ruins. The edifice is 45m high above the slope. ●

The structure of the vent edifice now visible in the photographs shows multiple successive flows,



Figure 170 –Mawson Peak from Atlas Cove. The edifice rises nearly 200m above the visible slope. ●



Figure 171 – Mawson Peak from the campsite near the ANARE ruins

Mt. Drygalski

Views from the Nullarbor

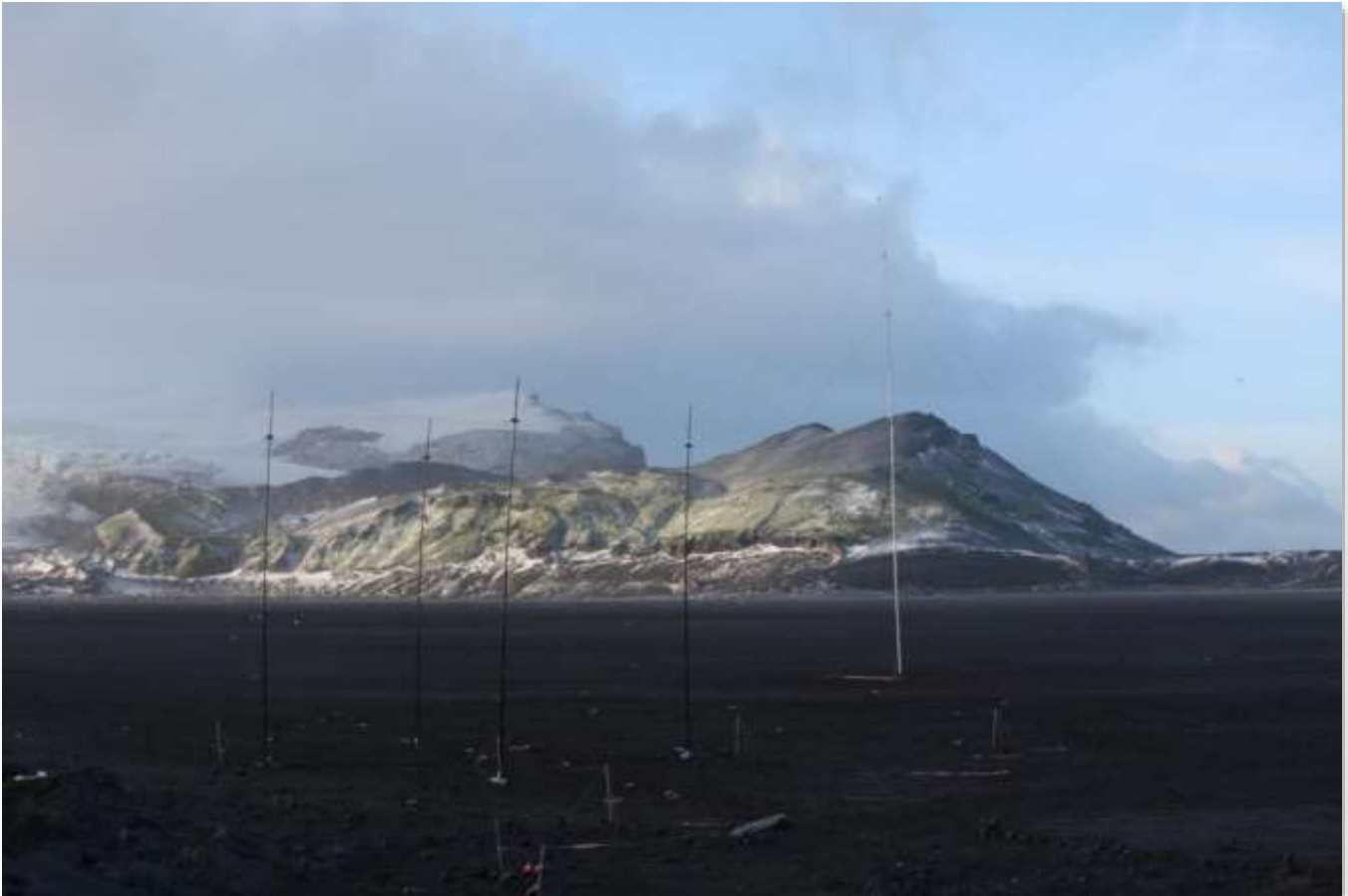


Figure 172 – Mt. Drygalski ●



Figure 173 – Mt. Drygalski



Figure 174 – Mt. Drygalski

Views from the summit



Figure 175 – Tip of Mt. Drygalski overlooking Atlas Cove



Figure 176 – View from Mt. Drygalski



Figure 177 – View from Mt. Drygalski



Figure 178 – View from Mt. Drygalski



Figure 179 – View SW to Schmidt Glacier

Outcroppings



Figure 180 – Pageos Moraine W to Vahsel Glacier



Figure 181 – Pageos Moraine



Figure 182 – Vicinity Mt. Drygalski



Figure 183 – Vicinity Mt. Drygalski



Figure 184 – Pageos Moraine S to Vahsel Glacier



Figure 185 – Pageos Moraine S to Vahsel Glacier



Figure 186 – Vicinity Mt. Drygalski



Figure 187 – Vicinity Mt. Drygalski

Streams and ponds



Figure 188 – South West Bay



Figure 189 – Waterfalls on West Rib of Schmidt Glacier



Figure 190 – Vahsel Glacier



Figure 191 – Valley on N side of Pageos Moraine

Azorella



Figure 192 – Valley on N side of Pageos Moraine



Figure 193 – View from Pageos Moraine to W end of West Rib



Figure 194 – Valley on N side of Pageos Moraine



Figure 195 – Slopes of Mt. Drygalski



Figure 196 – Vicinity Mt. Drygalski



Figure 197 – Vicinity Mt. Drygalski

Plants



Figure 198 – Vicinity Mt. Drygalski



Figure 199 – Vicinity Mt. Drygalski



Figure 200 – Vicinity Mt. Drygalski



Figure 201 – Vicinity Mt. Drygalski

Penguins



Figure 202 – King Penguin colony at base of West Rib rock wall



Figure 203 – King penguin colony (same as previous)



Figure 204 – King penguin colony (same as previous)



Figure 205 – King penguin colony (same as previous)



Figure 206 –Penguin feathers (same location as previous)

Nullarbor



Figure 207 – Nullarbor (Mt. Drygalski at rear right)



Figure 208 – Nullarbor (Mt. Drygalski at rear right)

Sediment

These photographs are of fine volcanic sediment and coarse rounded pebbles. Both were seen on the Nullarbor near the campsite. The patterning is obviously the result of overwash by wind-driven seawater. Ripple patterns are highly variable, depending on the nature of the grains, the flow over them, and the overlap of sequential processes in time.



Figure 209 – Nullarbor (patterns in the sediment)



Figure 210 - Nullarbor (patterns in the sediment)

Azorella Peninsula



Figure 211 – Azorella Peninsula



Figure 212 – Dovers Cone, Azorella Peninsula



Figure 213 – Rogers Head, Azorella Peninsula



Figure 214 – Corinth Head from Whart Point, ANARE ruins in foreground

Sealers Corner



Figure 215 – Sealers Corner (surf and ice debris)



Figure 216 – Sealers Corner (outcropping)



Figure 217 – Sealers Corner (remains of sealers hut at)

Baudissin Glacier



Figure 218 – Baudissin Glacier terminus



Figure 219 – Baudissin Glacier terminus

Rocks

Outcroppings



Figure 220 – Vicinity Mt. Drygalski



Figure 221 – Vicinity Mt. Drygalski



Figure 222 – Vicinity Mt. Drygalski



Figure 223 – Vicinity Mt. Drygalski



Figure 224 – Vicinity Mt. Drygalski



Figure 225 – Vicinity Mt. Drygalski



Figure 226 – Vicinity Mt. Drygalski



Figure 227 – Vicinity Mt. Drygalski



Figure 228 – Vicinity Mt. Drygalski



Figure 229 – Vicinity Mt. Drygalski



Figure 230 – Vicinity Mt. Drygalski

Frost shattering

Frost shattering is the result of many cycles of freeze-thaw



Figure 231 – Vicinity Mt. Drygalski



Figure 232 – Vicinity Mt. Drygalski



Figure 233 – Vicinity Mt. Drygalski



Figure 234 – Vicinity Mt. Drygalski



Figure 235 – Vicinity Mt. Drygalski



Figure 236 – Vicinity Mt. Drygalski



Figure 237 – Vicinity Mt. Drygalski



Figure 238 – Vicinity Mt. Drygalski



Figure 239 – Vicinity Mt. Drygalski



Figure 240 – Vicinity Mt. Drygalski



Figure 241 – Vicinity Mt. Drygalski



Figure 242 – Vicinity Mt. Drygalski



Figure 243 – Vicinity Mt. Drygalski



Figure 244 – Vicinity Mt. Drygalski

Pebbles



Figure 245 – Vicinity Mt. Drygalski



Figure 246 – Vicinity Mt. Drygalski



Figure 247 – Vicinity Mt. Drygalski



Figure 248 – Vicinity Mt. Drygalski



Figure 249 – Vicinity Mt. Drygalski



Figure 250 – Vicinity Mt. Drygalski

Ice

During the 2016 visit, Baudissin Glacier calved, creating a large ice debris field on the beach.



Figure 251 – Ice on the beach after Baudissin Glacier calved into Corinthian Bay •



Figure 252 – Icicles on an outcropping near Mt. Drygalski

Streams



Figure 253 – Glacier stream W side of Baudissin Glacier



Figure 254 – Same as previous



Figure 255 – Same as previous



Figure 256 – Same as previous



Figure 257 – Western flank of Baudissin Glacier

ANARE

The ANARE ruins were photographed from outside the perimeter set up in accordance with the Permit.



Figure 258 – Ruins of the ANARE station. All pictures on this page were taken from outside the Heritage Zone. ●



Figure 259 – ANARE ruins



Figure 260 – ANARE ruins



Figure 261 – ANARE ruins



Figure 262 – ANARE ruins

Survey markers



Figure 263 – Control station at the ANARE site



Figure 264 – Control station at the ANARE site



Figure 265 – Control station at the ANARE site

Seals



Figure 266 – Elephant seal on Laurens Peninsula



Figure 267 – Elephant seal on Laurens Peninsula



Figure 268 – Elephant seal on Laurens Peninsula



Figure 269 – Elephant seal on Laurens Peninsula



Figure 270 – Elephant seal at campsite Atlas Cove



Figure 271 - Seal endures a sandstorm at Sealers Corner



Figure 272 – Fur seal pup



Figure 273 – Leopard seal

Penguins

Individuals



Figure 274 - King



Figure 275 – King



Figure 276 – Macaroni (probable ID)



Figure 277 – Rockhopper

Groups



Figure 278 – It was common to see a line of King penguins in which the end members were looking outward.



Figure 279 – These King penguins were fascinated with the sandbags, perhaps thinking they were penguins.



Figure 280 – This group was caught in a sandstorm on Corinthian Bay beach.

Birds



Figure 281 – Heard Island cormorant



Figure 282 – Southern Giant petrel



Figure 283 - Albatross



Figure 284



Figure 285 – Prion



Figure 286



Figure 287



Figure 288 - Skua



Figure 289 - Skua



Figure 290 - Skua



Figure 291 - Sheathbill



Figure 292 - Gull



Figure 293 - Antarctic tern



Figure 294 - Heard Island cormorant



Figure 295



Figure 296 – Southern giant petrel



Figure 297 – Southern giant petrel group

Animal tracks



Figure 298 - Elephant seal



Figure 299 - Penguin



Figure 300 - Seabird



Figure 301 - Seabird

Plants

Azorella and



Figure 302 - Azorella



Figure 303 – Azorella close-up



Figure 304 – Azorella and Kerguelen cabbage



Figure 305 – Mixed field of Azorella and Kerguelen Cabbage

Kerguelen cabbage



Figure 306 – Kerguelen cabbage



Figure 307 – Kerguelen cabbage

Lichens and other plants



Figure 308 – Crustose lichens (yellow) on rocks



Figure 309 – Crustose lichens on rocks



Figure 310 – Crustose lichens on rocks



Figure 311 – Crustose lichens on rocks



Figure 312 – Seaweed?



Figure 313 – Grass?



Figure 314 – Kelp?



Figure 315 – Seaweed?

Debris

Inorganic



Figure 316 – Marine fender or float



Figure 317 - Marine fender



Figure 318 - Marine fender



Figure 319 - Tarpaulin



Figure 320 – Plastic bottle



Figure 321 – Plastic bottle



Figure 322 – Plastic bottle



Figure 323 – Aluminum can



Figure 324 – Electronic device (from weather balloon?)



Figure 325 - Batteries



Figure 326 - Float



Figure 327 - Fenders



Figure 328 – Propane canister



Figure 329 – Parts from an unidentified mechanical device



Figure 330 – Propane canister



Figure 331 – Fuel drum

Organic



Figure 332 - Feather



Figure 333 - Jellyfish



Figure 334 - Jellyfish



Figure 335 – Unidentified skeletal remains



Figure 336 – Unidentified skeletal remains

Bonal



Figure 337 – Dolphin skull



Figure 338 – Dolphin skull



Figure 339 – Dolphin skull



Figure 340 – Leopard seal jaw



Figure 341 – Seal vertebrae



Figure 342 – Seal vertebrae



Figure 343 – Seal pelvis



Figure 344 – Seal pelvis



Figure 345 – Seal vertebra



Figure 346 – Seal vertebra



Figure 347 – Seal vertebra



Figure 348 – Seal vertebra



Figure 349 – Seal vertebral disk



Figure 351 – Unidentified bone



Figure 350 – Unidentified bone

Penguin carcasses



Figure 352 – Penguin carcass, prob. Leopard seal kill



Figure 353 – Penguin carcass, prob. Leopard seal kill



Figure 354 – King penguin skeleton. Note the intact feet. •

Gigapan images

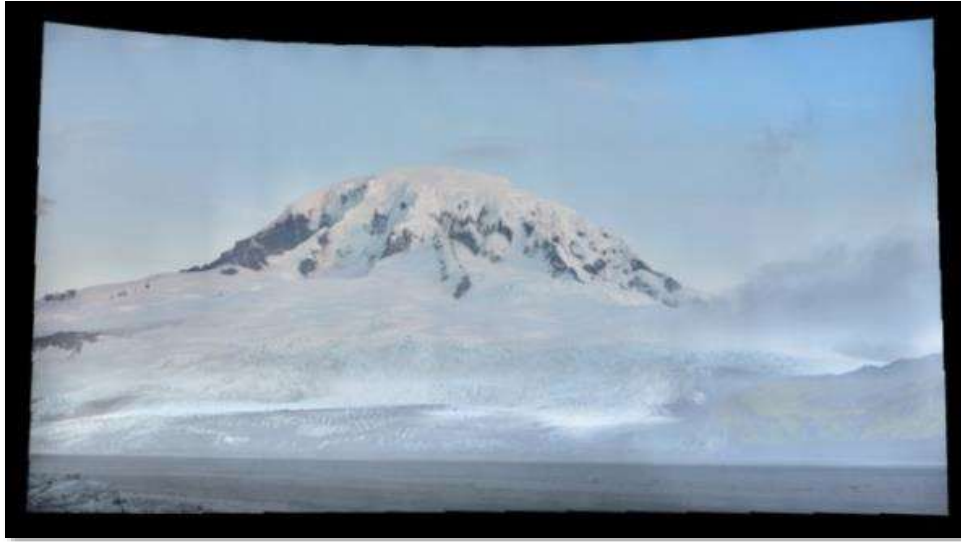


Figure 355 – Gigapan image of Big Ben

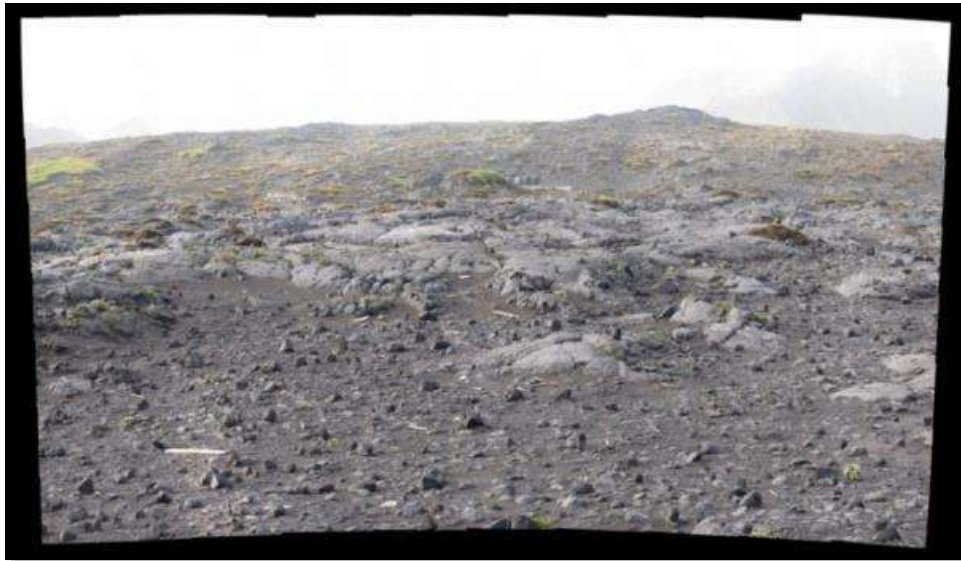


Figure 356 – Gigapan image of the southern limit of the Azorella Peninsula



Figure 357 – Gigapan image of the southern limit of the Azorella Peninsula

Clouds

The top of Big Ben is usually obscured by clouds, and often clouds are found in an interval of altitudes below the peak. The volcano forms a solid barrier to the winds, shedding vortices. Sometimes lenticular clouds are formed, which can move a considerable distance from the mountain.



Figure 358 – Lenticular cloud



Figure 359 – Lenticular cloud



Figure 360 – Lenticular cloud



Figure 361 – Lenticular clouds



Figure 362 – Cumulus clouds over Big Ben



Figure 363 – Overcast near Atlas Cove



Figure 364 – Clouds framing Big Ben

Shadow of the mountain

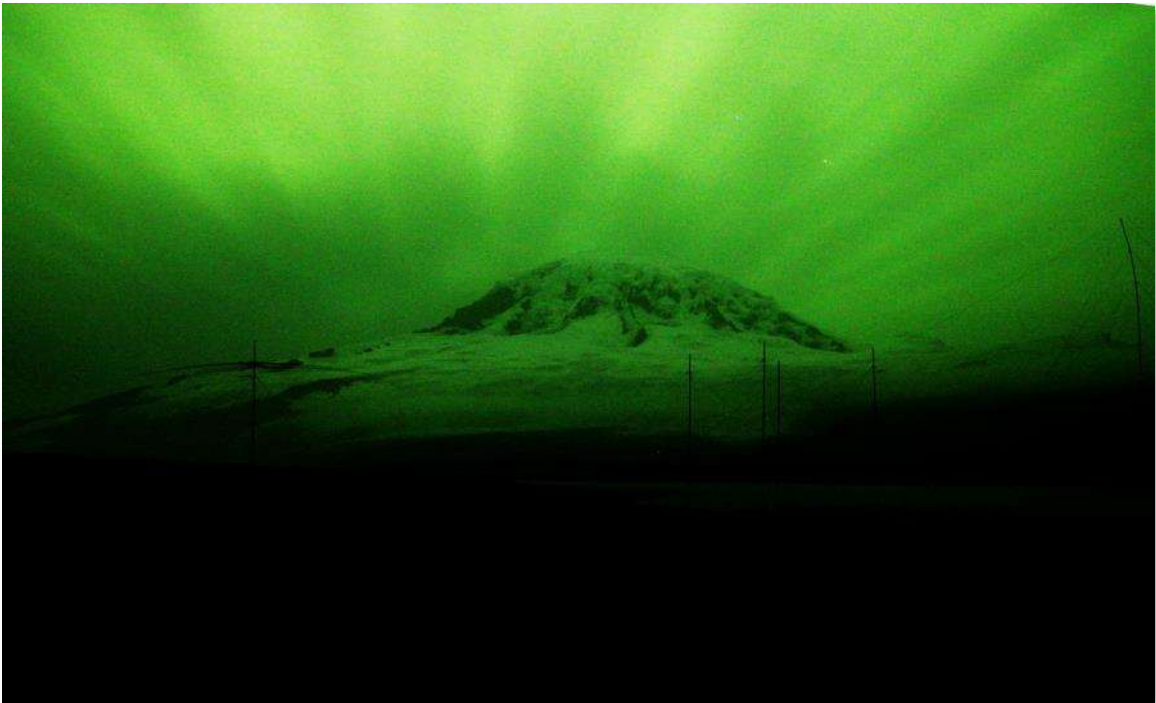


Figure 365 – Shadow created by Big Ben

Rainbow

This photograph of a rainbow, looking SW from the campsite, is greatly enhanced.



Figure 366 - Rainbow

Sunrise



Figure 367 – Sunrise over Corinthian Bay



Figure 368 – Sunset alpenglow on Big Ben

Southern Sky

On 10 April 2016 team member Bill Mitchell several images of the night sky above Atlas Cove:



Figure 369 – Night sky seen from Atlas Cove 10 April 2016 4:27 PM (local)

Star charts and southern sky image enable us to easily to identify two major well-known features: the Southern Cross and Alpha/Beta Centauri.

Alpha Centauri is the closest star system to the Solar System at a distance of 4.37 light-years. To the unaided eye, it is the brightest star in the southern constellation Centaurus. South of about 29°S latitude (Heard Island is 53°S), Alpha Centauri is circumpolar and never sets below the horizon. Given the similarities to the Sun in spectral types, star type, age and probable stability of the orbits, it has been suggested that this stellar system could hold one of the best possibilities for harboring extraterrestrial life on a potential planet, and it is envisioned as a likely first target for interstellar exploration. [Source: Wikipedia]



Figure 371

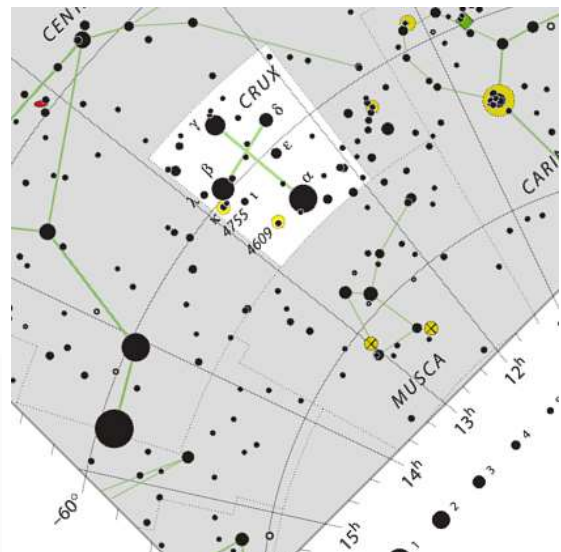


Figure 370 The constellation Crux [Wikipedia]

The Southern Cross is part of the symbolism on the flags of Australia, New Zealand, and several other countries. The picture at right shows the Australian flag that was flown over the 2016 campsite at Atlas Cove.

Aurora Australis

On 12:30 AM 31 March 2016 Alan Cheshire photographed Aurora Australis over Big Ben as seen from the campsite. The camera was pointed at 123° (SEbyE) and the peak of Big Ben is at about 12° elevation. Cheshire pointed out that a star chart for the date and time confirms the star field rising above Big Ben is the constellation Scorpius, and the bright object to the right of the mast silhouette is the planet Mars'



Figure 372 – Aurora Australis and the constellation of Scorpius rising over Big Ben 31 March 2016

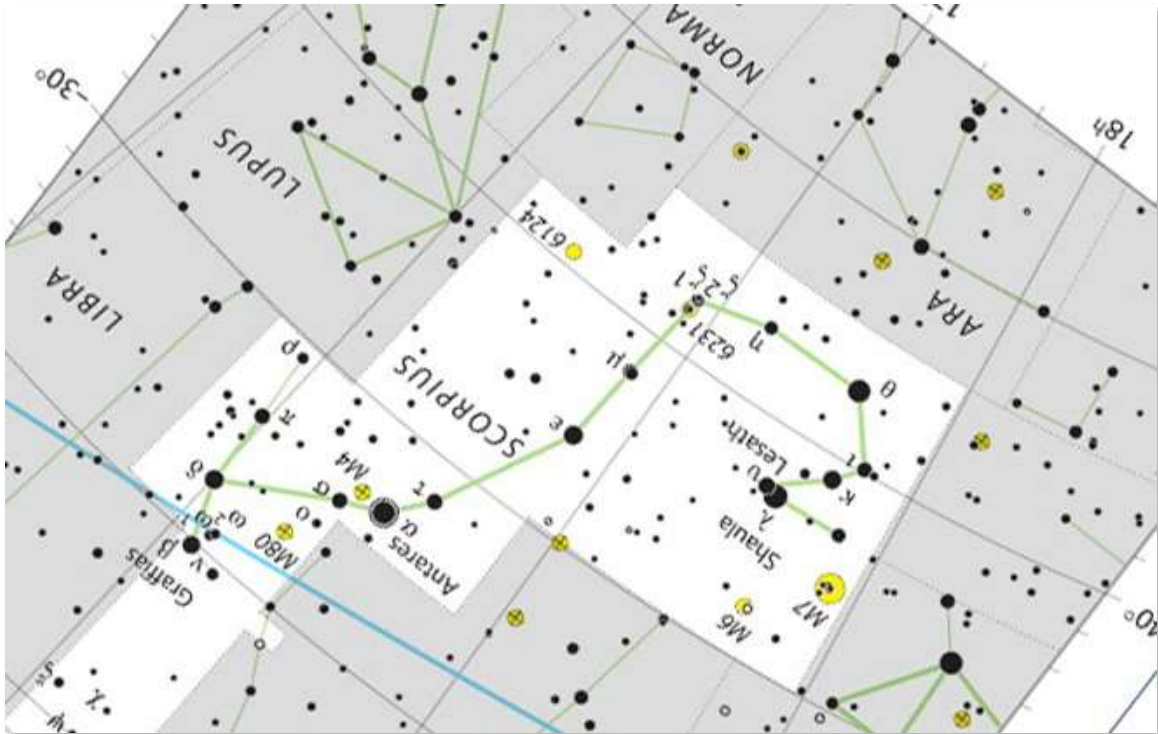


Figure 373 –The constellation of Scorpius [Wikipedia]

Laurens Peninsula

Fred Belton and Gavin Marshall spent three days on the northern end of Laurens Peninsula. The track of their movement is shown in the section on SPECIMENS. In the following sections, we show photographs of the Peninsula seen from Atlas Cove and during their trek. The value of these photographs is their relevance to historical and future photographs that could give insight into changes and their rates.

Landscape



Figure 374 – Charles Carrol Bluff on Laurens Peninsula, looking southeast from the Braveheart



Figure 375 – Laurens Peninsula, looking northwest from Atlas Cove



Figure 376 – Laurens Peninsula seen from the Nullarbor



Figure 377 – Laurens Peninsula seen from the Nullarbor



Figure 378 – Mount Aubert De La Rue, seen from the campsite



Figure 379 – Laurens Peninsula seen from the Nullarbor



Figure 380 – Laurens Peninsula seen from the campsite



Figure 381 – Laurens Peninsula seen from the campsite



Figure 382 – General view of Laurens Peninsula from the campsite ●



Figure 383 – General view of Laurens Peninsula



Figure 384 – General view of Laurens Peninsula



Figure 385 – General view of Laurens Peninsula



Figure 386 – General view of Laurens Peninsula



Figure 387 – The Sentinel



Figure 388 – Desperation Gully through to ANZAC Peak

North Laurens views

Rocky shore

In the following 4 pages, we present photographs of the northern region of Laurens Peninsula. These are sorted as rocky shore, hilly, debris, penguins, animals, and apple shelter.



Figure 389 – Magnet Point



Figure 390 – Magnet Point



Figure 391 – Laurens Peninsula environment



Figure 392 – Laurens Peninsula environment



Figure 393 – S end of Sydney Cove



Figure 394 – S end of Sydney Cove

Hilly



Figure 395 – Rockhopper penguins, N end Laurens Peninsula



Figure 396 – Laurens Peninsula environment



Figure 397 – South of apple hut shelter



Figure 398 – South of apple hut shelter

Debris



Figure 399 – (Sydney Cove) Long line or net float



Figure 400 – (Sydney Cove) Tyre used as a marine fender, or possibly windblown from the ANARE ruins

Penguins



Figure 401 – Terrace above Red Island isthmus



Figure 402 – Heard Island cormorants, N end Sydney Cove



Figure 403 – Gentoo penguins, N end Sydney Cove



Figure 404 – Gentoo chicks moulting



Figure 405 – King penguins, Sydney Cove



Figure 406 – King penguins, including chicks, Sydney Cove

Seals



Figure 407 – Young elephant seals, Sydney Cove. Note the red marine fender.



Figure 408 – Fur seal pup



Figure 409 – Fur seal pup

Apple shelter



Figure 410 – Sydney Cove apple hut shelter, Red Island in the distance to the north

Red Island

Overview

On the northern tip of Laurens Peninsula is a feature known since 1874 as “Red Island.” In fact, until ten years ago it was not an island; it was connected to Laurens Peninsula by a low narrow isthmus, rather much resembling a long-necked bird. The east side the isthmus forms Sydney Cove, while the west side is a long unprotected west-facing coastline. The 2016 expedition documented the fact that very recently the isthmus has been breached by two channels, one on the east and one on the west, thus isolating Red Island as a true island.



Figure 411 – Red Island seen from the north, upon approach to Atlas Cove. 22 March 2016



Figure 412 – Sydney Cove looking north 30 March 2016



Figure 413 – Red Island from Sydney Cove 30 March 2016

Penguin colony

The summit of Red Island is home to a large colony of (probably Rockhopper) penguins. It was not possible to confirm the species, but estimated population is greater than 10,000.



Figure 414 – Penguin colony on the top of Red Island 30 March 2016



Figure 415 – Detail 30 March 2016



Figure 416 – Satellite image of penguin colony (2014, enhanced)

Red Island Isthmus

Apparently there is no evidence that Red Island was ever actually an island. Instead, it has been joined to the larger Laurens Peninsula by a narrow low lying isthmus about 1 km long. Satellite images from 2006 show that the isthmus contains a shallow 3-lobbed lagoon, held in by seawalls no more than 3-4m high. During the 2016 expedition this area was seen to be extensively flooded, including a wide channel that is roughly the location of the northern lobe of the lagoon, and a narrow channel that connects the sea on the east side (Sydney Cove) with the wide lagoon-channel. The image below is a composite of three photographs taken from a slope near Magnet Point, about 1 km distant.



Figure 417 – Composite image of Red Island and the isthmus in 2016 •



Figure 418 – The channel across the isthmus that now defines Red Island as an actual island

Islet in Sydney Cove

At the south end of Sydney Cove, there is a small islet, ca. 40m x 120m. This islet shows classic features of hexagonal jointing, but it also has some mysterious structures on its top surface. This is described in detail later.



Figure 419 – Islet in Sydney Cove



Figure 420 – Islet in Sydney Cove

Stephenson Lagoon

Views from outside

Braveheart anchored about a mile to the SW of the south breakwater that previously confined Stephenson Lagoon. It was immediately obvious that the breakwater is undergoing rapid erosion in the face of intense surf pounding. A question that was posed for this investigation, namely the extent of mixing of seawater with the freshwater runoff into the lagoon, is therefore moot: the lagoon is completely mixed due to tidal flow. Due to the unworkable sea state, Braveheart waited at anchor for one day, allowing us to photo-document the appearance of Big Ben from the side opposite Atlas Cove.



Figure 421 – Big Ben seen from outside the south entrance to Stephenson Lagoon, looking NW ●



Figure 422 – The south entrance into Stephenson Lagoon, seen from the outside 5 April 2016

South breakwater

The satellite picture from 2014 (below) shows major rocks and/or shingle bars; these are now almost totally eroded away.



Figure 423 – Satellite image (2014) of the south entrance



Figure 424 – The south entrance, on 5 April 2016 ●



Figure 425 – The west side of the south entrance



Figure 426 – Another view of the west side of the south entrance

Views inside the lagoon



Figure 427 – Stephenson Lagoon, from the north shore looking SE. Dovers Moraine in the distance.



Figure 428 – Stephenson Lagoon from the north shore, looking south along the west shore

Glacier

One of the most prominent sights encountered upon entering the Stephenson Lagoon through the south breakwater is a huge pan-shaped feature, rimmed by a prominent terminal moraine. The structure is about 1.2 km in diameter. The moraine is 100-200m wide and perhaps 50m high, and it is covered with a layer of 1-2m of mixed rounded gravel, giving it the color of rocks in the satellite images. The moraine is riddled with a large number of bare ice slumps, with a wide distribution of sizes, showing that it is predominantly ice rather than rocks. The glacier lies between the stubs of the Winston Glacier and the Stephenson Glacier. The original “blue gash” is on the southern part of this moraine. This glacier carries the designation AU1141.



Figure 429 The glacier AU1141 to the west of Stephenson Lagoon. The terminal moraine shows many ice slumps.

This glacier probably feeds the tarn and it may also directly supply the stream that flows into the Stephenson Lagoon carrying the large sediment load.

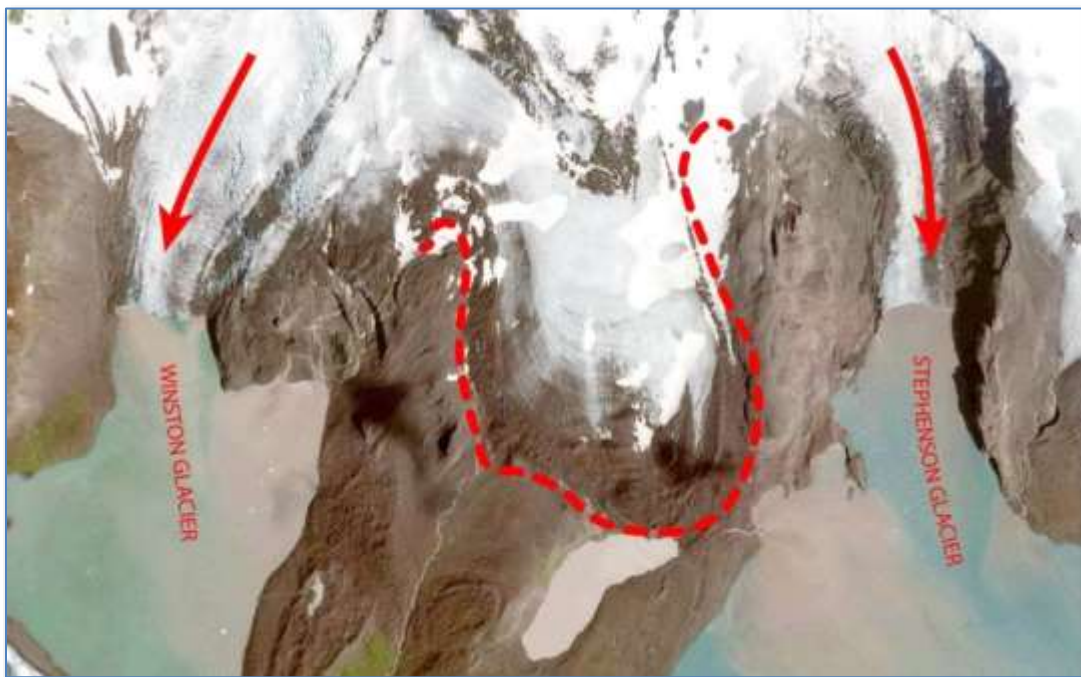


Figure 430 - Glacier AU1141 lies between the Winston and Stephenson Glaciers. North is to the right.

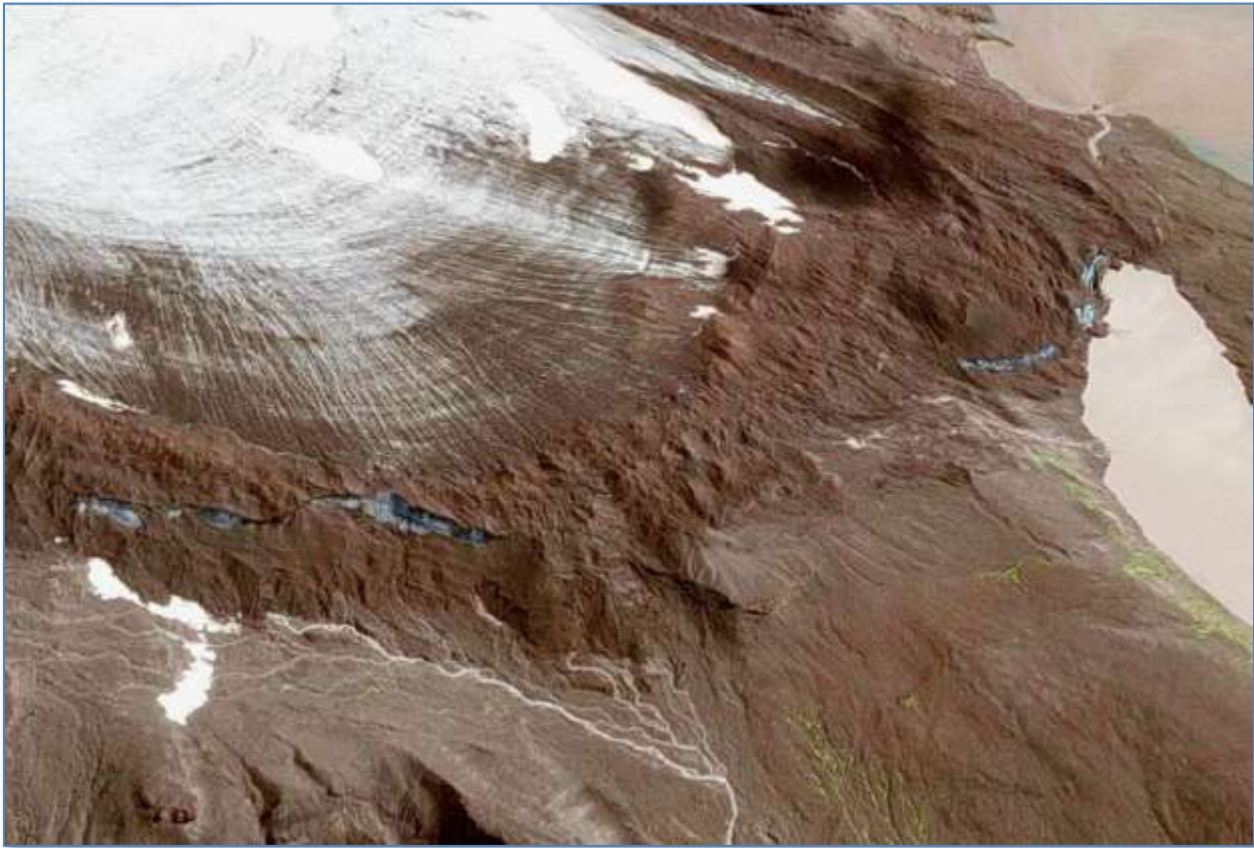


Figure 431 – Google Earth image (tilted) of Glacier AU1141 to the west of Stephenson Lagoon •

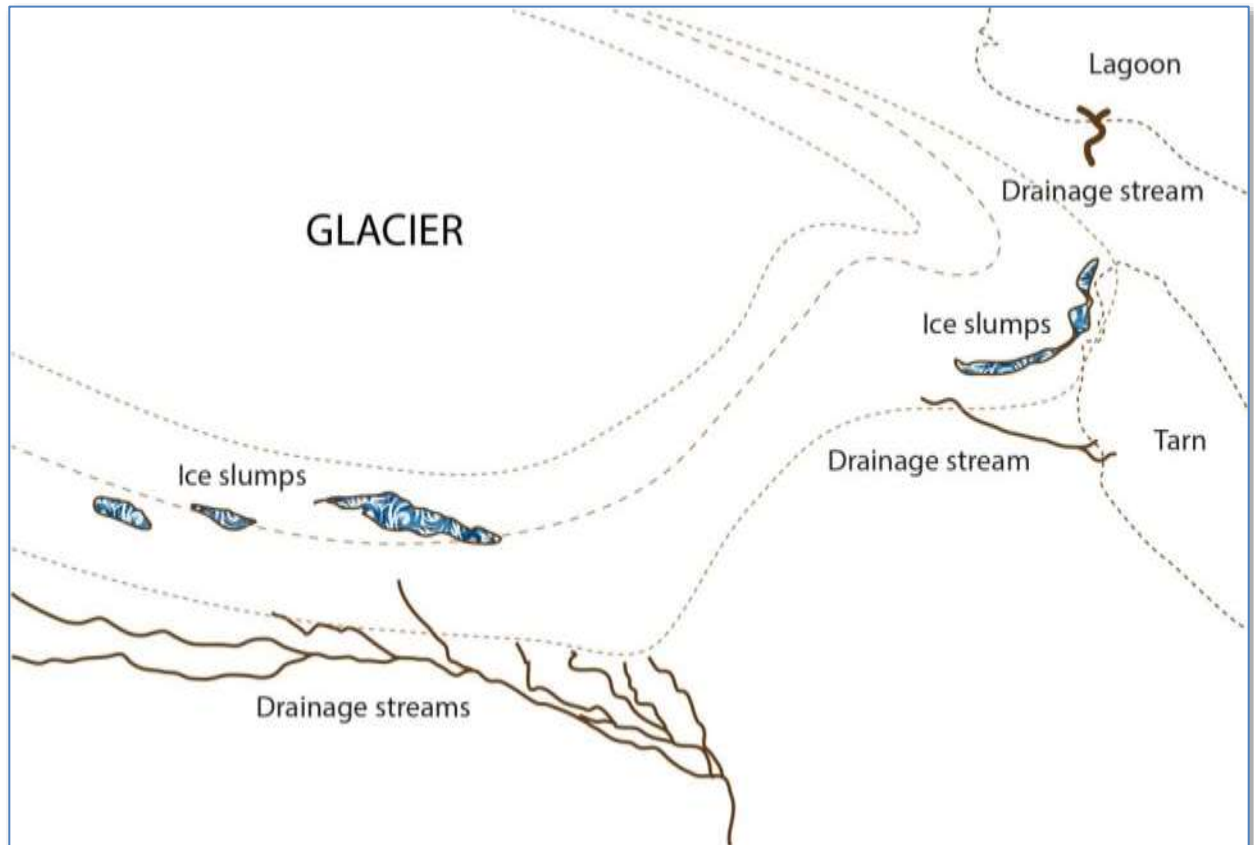


Figure 432 – Diagram of the previous image

←(Left) The Google Earth image and its key show details of the glacier. These features show that the moraine is predominantly ice covered with a veneer of unsorted gravel, rather than gravel alone, hence the large pan-shaped area is certainly a glacier rather than a lava flow.

South terminal moraine

The south terminal moraine wraps around Smith Bluff to its left in the photo below.



Figure 433 – The south terminal moraine 5 April 2016



Figure 434 Detail of the south terminal moraine 5 April 2016

Central terminal moraine

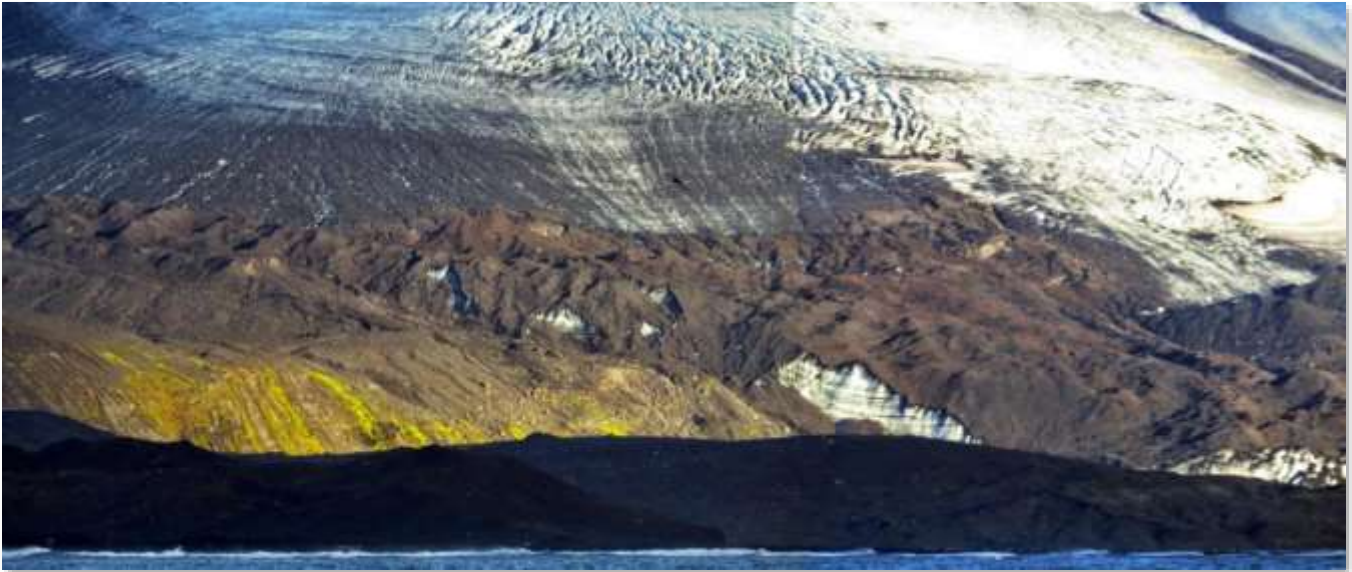


Figure 435 – The central part of the terminal moraine. Note the extensive ice slumps.



Figure 436 – Detail of the previous picture, showing some of the ice slumps.

North terminal moraine



Figure 437 – The north part of the terminal moraine, also showing extensive ice slumping.



Figure 438 – Detail (enhanced) of previous picture, showing extensive ice slumping

Smooth features

The photo below is of a detail of a feature seen at the edge of the glacier, inside the flow that feeds the northern moraine. The appearance of this feature is that it is flat and smooth. It seems to be an extrusion, or possibly a lake. But it also appears to be on a slope, and furthermore the camera was at sea level, so if it were a body of water, it would not have been visible to the camera. Thus, we believe it is most likely solid ice that was somehow smoothed. As of this writing, we do not have an explanation for this feature. However, the second photo below, seen from Braveheart at anchor, also shows a feature very similar to the first.



Figure 439 – Detail of a previous image of the glacier 5 April 2016



Figure 440 – Another example of a smooth deposit seen from the Braveheart outside the lagoon 5 April 2016

Ice slumps

In preparing for this expedition, we studied the details of the satellite images of Heard Island (Google Earth, 2014). Among numerous features that were found is the image shown below. This “blue gash” is about 250m long, 50m high at its peak. Provisionally we proposed that the process is as follows: the ice wall is removed by melting, sublimation, or precipitation, gradually undercutting the gravel overlay. Eventually the overlay collapses, breaking off in chunks and sliding down the steep ice face, piling up at the bottom. We refer to this process as “ice slumping” and the structures and “ice slumps.” During the expedition, we photographed hundreds of these features in all sizes; from a metre to many hundreds of metres across.



Figure 441 – A spectacular ice slump (ca. 250m long) on the south terminal moraine

The next image is of an ice slump on the Black Rapids Glacier in the Alaska Range [source]. The slumping over the ice face is obvious in this image. The similarity to the features on Heard Island is striking.



Figure 442 – An ice slump in Alaska. This slump is almost identical to those seen on Heard Island.

The next four images show spectacular examples of ice slumping in the glaciers near Stephenson Lagoon.



Figure 443 – Photographed from inside Stephenson Lagoon 5 April



Figure 444 – Photographed from inside Stephenson Lagoon 5 April



Figure 445 – Photographed from inside Stephenson Lagoon 5 April 2016



Figure 446 – Photographed from inside Stephenson Lagoon 5 April

West shore



Figure 447 – The west shore comprises a mixed-size and mixed-composition gravel (cf. pebble photos next page). 5 April 2016



Figure 448 – The west shore



Figure 449 – The west shore



Figure 450 – The west shore



Figure 451 – The west shore



Figure 452 – The west shore



Figure 453 – The west shore



Figure 454 – The west shore



Figure 455 – The west shore

Tarn

(Right) About 0.5 km west of the Stephenson Lagoon is a persistent tarn, about 1 km long and a little over 275m wide. The tarn is very muddy, obviously due to the multiple runoff streams feeding it from the large glacier above it to the west.

(Next page) The satellite images (Google Earth 2014) show a feature that changed sometime after 2007. This feature was mysterious; the 2D images allowed only poor understanding of its structure. Thus, it became a primary target for the 2016 expedition. Gavin Marshall and Fred Belton were able to reach this tarn. Their pictures show clearly that the feature is an ice slump, probably triggered by the drainage stream that continued to flow after the slump occurred. The gravel deposits around the tarn are mixed sizes and composition.



Figure 456 – 2014 satellite image of the tarn



Figure 457 - The tarn from the north April 2016



Figure 458 – North end of the tarn 5 April 2016



Figure 459 – Mixed gravel deposits at the tarn 5 April 2016

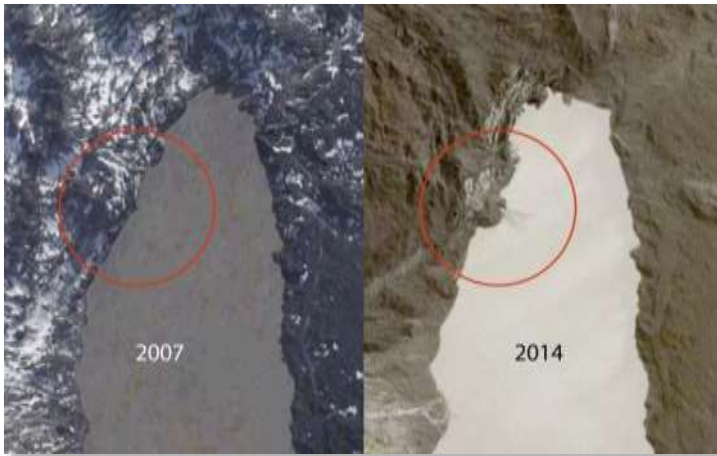


Figure 460 – Satellite images from 2007 and 2014



Figure 461 – Enhanced detail of the tarn



Figure 462 – The ice slump in the previous two images, Photographed 5 April 2016 •



Figure 463 – Gravel at the tarn



Figure 464 – Gravel at the tarn

Lagoon inlet stream

The 2014 satellite images show that a little less than 300m from the north end of the tarn is a stream that appears to emanate directly from the substrate, flows about 170m downhill by about downhill about 20m, and then flows into the Stephenson Lagoon. However, the image was ambiguous: it was not clear whether the stream emanated from rock or ice. What was clear was that it carries a heavy sediment load, which spreads out into the Stephenson Lagoon. Most of it probably settles on the bottom. The stream carries a heavy load of fine sediment, and the satellite images show how this plume spreads into the lagoon. [Source Google Earth 2014 image processed]



Figure 465 – Satellite image of the inlet stream

The 2016 team was landed on the west shore and walked up to the origin of the stream, which was found to be a narrow slit (ca 0.5 m high). From calibrated photographs, we estimate the flow to be about 10m³/s.



Figure 466 – The origin of the inlet stream



Figure 473 – The origin of the inlet stream. Clearly it is a drainage for the glacier above it.



Figure 467 – The stream proceeding to the lagoon



Figure 468 – The stream proceeding to the lagoon



Figure 469 – The stream



Figure 470 – The stream approaching the lagoon



Figure 471 – At the lagoon, the stream bifurcates around a relatively stable gravel deposit. The images on this page were taken from 53°7.23'S, 73°40.22'E.

Stephenson Glacier

The 2014 satellite images (right, Google Earth) showed the main structure of Stephenson Glacier. The 2016 visit confirmed those images, but also had the advantage of being able to image vertical features not seen by the satellite.

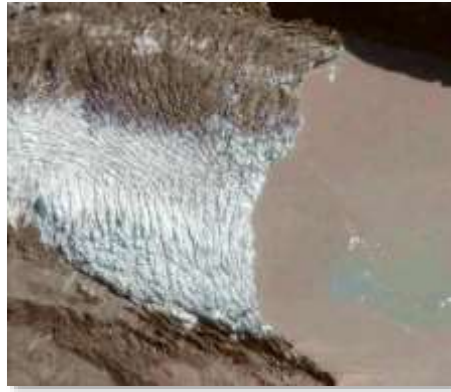


Figure 472 – The terminus (looking north)

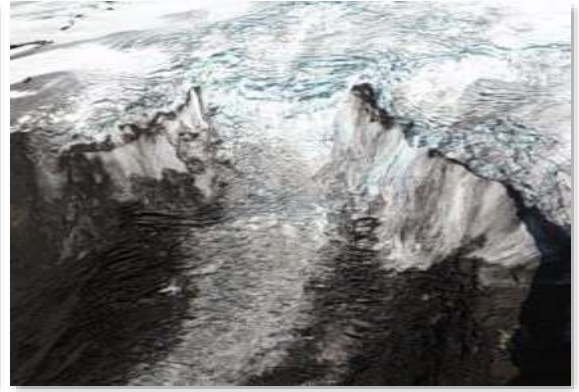


Figure 473 – The confining cliffs [looking west]



Figure 474 – Stephenson Glacier 5 April 2016 ●



Figure 475 – The terminus 5 April 2016



Figure 476 – The high cliffs above Stephenson Glacier 5 April 2015



Figure 477 – The central vertical wall, showing prominent cylindrical structures. Black cinders flow down the midline.



Figure 478 - The south lateral edge



Figure 479 – The north lateral edge

Cliffs above the glacier

On the north wall above Stephenson Glacier there is a vertical cliff more than 100m high overlain with a glacial icepack about 40m thick. Numerous streams drain from its floor, falling uninterrupted down the cliff. The advance of the glacier produces a pile of ice at the foot of cliff. This cliff cannot be seen in the satellite images. The two lower pictures were taken ten minutes apart, hence have very slightly different parallax. Because of this these two images for a stereoscopic pair.

(Next page) Seen from the lagoon, the edge of Stephenson Glacier is a chaotic jumble.



Figure 480 – The cliff on the north margin of Stephenson Glacier.



Figure 481 – The western falls in calm (stereo image left)



Figure 482 – The western falls in wind (stereo image right)



Figure 483 – The edge of the glacier ice as seen from the lagoon

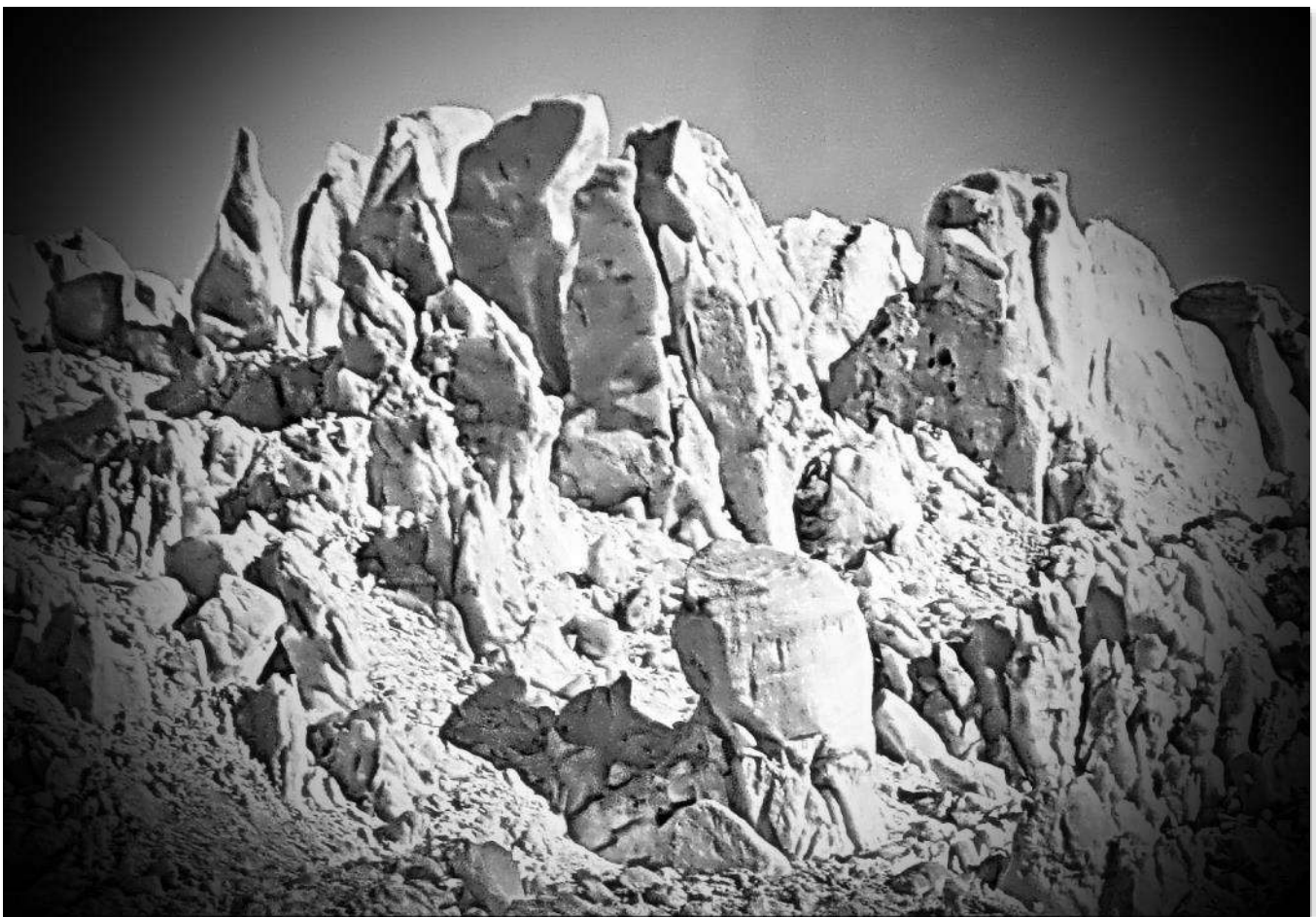


Figure 484 – Detail of the previous photograph

High ridges

From Braveheart at anchor off the south entrance to Stephenson Lagoon, we had good views of Big Ben, affording good photographs of the high cliffs. Some of these are shown here and the next pages.



Figure 485 – Big Ben from outside the Spit, looking northwest. The high ridges are shown in more detail in following photographs.



Figure 486 – The central two high ridges ●



Figure 487 – The left high ridge



Figure 488 – The right high ridge



Figure 489 – The ridge to the north. The ice walls on the cliff face are amazingly parallel.



Figure 490 – A high ridge with a remnant column



Figure 491 – Detail of photo above



Figure 492 – Detail of photo above



Figure 493 –Cliff above Stephenson Glacier. The cliff is rock, not ice.



Figure 494 – A complex layered bluff on the edge of Stephenson Lagoon



Figure 495 – Detail of photo above: plants



Figure 496 – Detail of photo above: a small ice slump

East shore

Two landings were made on the east beach, shown in the chart of the track of the service boat shown earlier. Specimens were collected in both locations: The photographs below are of the second stop.

GPS coordinates: Stop 1: (53.01915863°S,73.39493726°E). Stop 2: (53.01914396°S,73.39488245°E).



Figure 497 – The second landing on the east shore 5 April 2016



Figure 498 – Looking southwest



Figure 499 – Looking south



Figure 500 – Looking northeast



Figure 501 – Looking northeast



Figure 502 – Looking northeast

The rock shown below was found on the beach at the second stop on the east shore. It is obviously a very complex conglomerate.



Figure 503 – A conglomerate seen at the second landing on the east shore. About 25 cm long.



Figure 504 – Detail from previous photo.



Figure 505 – Detail from previous photo.

North shore

The north shore was visited on 5 April 2016. The team took a series of photographs covering 360° around a point on the moraine that peaked about 10m above the lagoon. The curvature of the moraine is likely due to its deposition by the Stephenson Glacier at this location. Several small ponds near the landing point were approximately as seen in the 2014 satellite image. The vegetative cover on the moraine is much lighter than in the flat valley, probably due to the absence of soil that can retain nutrients and water.



Figure 506 – The visit to the north shore



Figure 507 – Looking southwest



Figure 508 – Looking northwest



Figure 509 – Looking northeast



Figure 510 – Looking west

GPS coordinates of photos on the previous and this page: (53.01914262°S,73.39492964°E)

North breakwater

The 2014 satellite image shows the north breakwater to be almost intact. However, during the 2016 visit, the team found it to be almost totally eroded away. There is little doubt that within a few years,



Figure 512 – The north breakwater (satellite 2014) Figure 511 – Detail of the image to left

it will be completely awash, the same way the south breakwater has been reduced to washrocks and breakers.

The photo below was taken from the ridge at the north end of the lagoon. The land at far right is the edge of Dovers Moraine and Trypot Beach.



Figure 513 – The north breakwater. Comparing this with the satellite images shows that it is undergoing rapid

Colony at south breakwater

On both sides of the south breakwater are large colonies of seals and penguins. This is the west side.



Figure 514 – The seal/King penguin colony on the west side of the south entrance.



Figure 515 – King penguins on the beach on the west side of the south entrance.



Figure 516 – Elephant seals on the beach on the west side of the south entrance.

Floating ice

There was practically no ice in the lagoon. What ice we saw was water-worn.



Figure 517 – A relatively rare “bergy-bit” in the lagoon



Figure 518 – A hand sample of the glacial ice

Plants

These plants were photographed at the north shore, but they were seen at many places around the lagoon.



Figure 519 – Azorella clump



Figure 520 – Kerguelen cabbage



Figure 521 – Kerguelen cabbage flower

Biodebris

These penguin bodies were found on the east shore (upper two photos) and south shore (lower photo).



Figure 522 – Penguin carcass



Figure 523 – Penguin carcass



Figure 524 – Remnant animal body found at the colony on the south shore. The author believes it is a penguin. ●

Clouds

These cloud formations were observed from the region around Stephenson Lagoon 5 April 2016.



Figure 525 – Clouds (probably a Foehn cloud)



Figure 526 - Clouds



Figure 527 - Clouds •



Figure 528 - Clouds



Figure 529 - Clouds



Figure 530 - Clouds



Figure 531 - Clouds



Figure 532 - Clouds



Figure 533 - Clouds



Figure 534 - Clouds



Figure 535 - Clouds



Figure 536- Clouds



Figure 537- Clouds



Figure 538 - Clouds

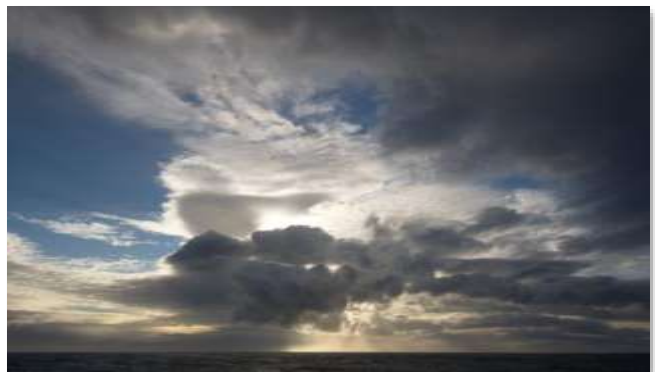


Figure 539 - Clouds

6. SPECIMENS

Locations

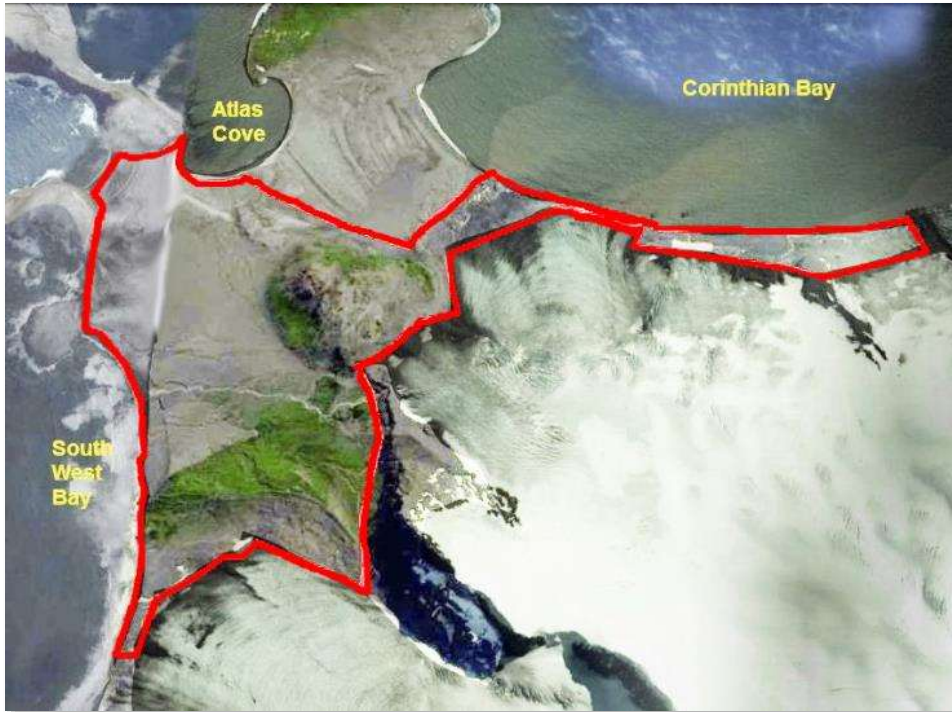


Figure 540 – Permitted areas for specimen collection on the Nullarbor

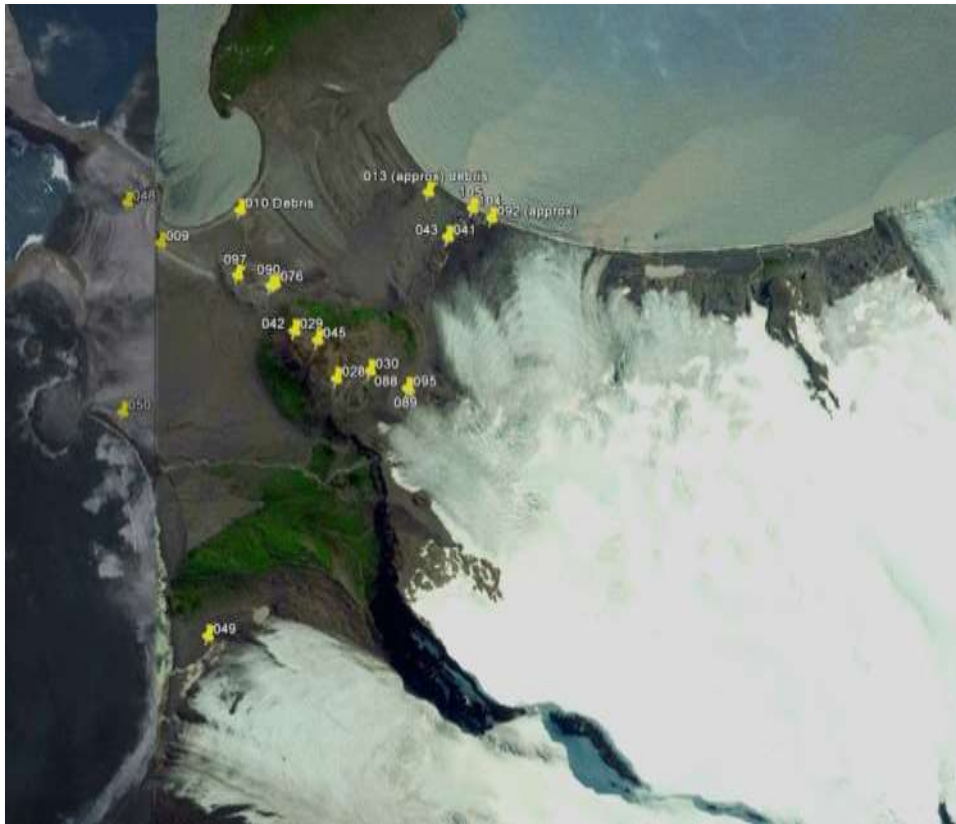


Figure 541 – Actual locations of specimen collections

The following diagram, recorded by Fred Belton on his GPS, shows the locations of the logged positions during the exploration of the area around Atlas Cove on multiple days during the stay on Heard Island. Descriptions of some of these excursions are available in the log of Gavin Marshall [here](#).



Figure 542 – Tracks of the team during photodocumentation and specimen collection in the Atlas Cove Nullarbor area



Figure 543 – Permitted areas for specimen collection on Laurens Peninsula



Figure 544 – Actual locations of specimen collections

The following diagram, recorded by Fred Belton on his GPS, shows the tracks of his exploration of the northern region of Laurens Peninsula on multiple days during the stay on Heard Island, and the locations of the numbered specimens. Descriptions of some of these excursions are available in the log of Gavin Marshall [here](#).

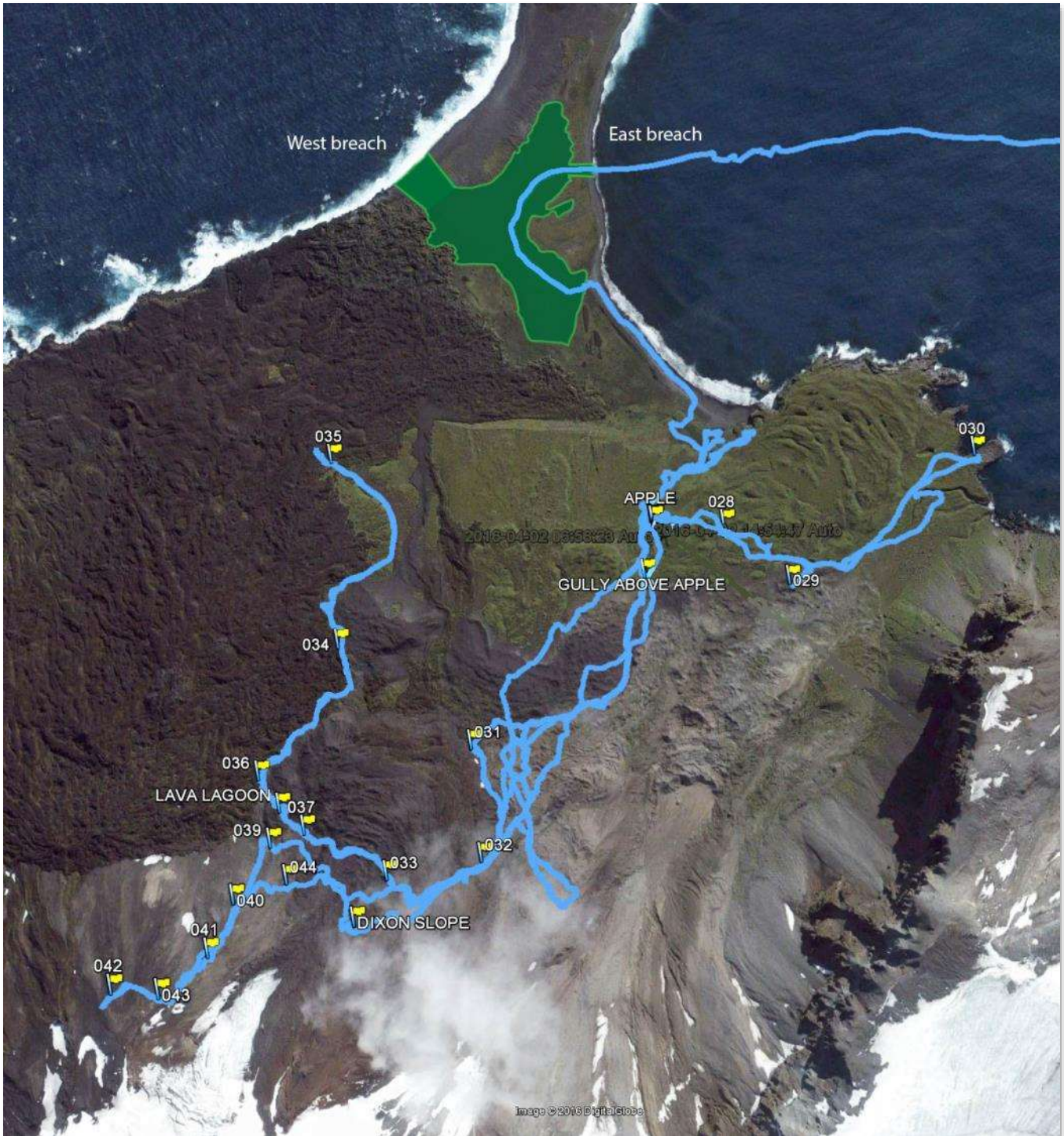


Figure 545—Tracks of the team during specimen collection on Laurens Peninsula

The power launch from Braveheart delivered and recovered Belton and Marshall by entering the small lagoon now open to Sydney Cove through the East breach.

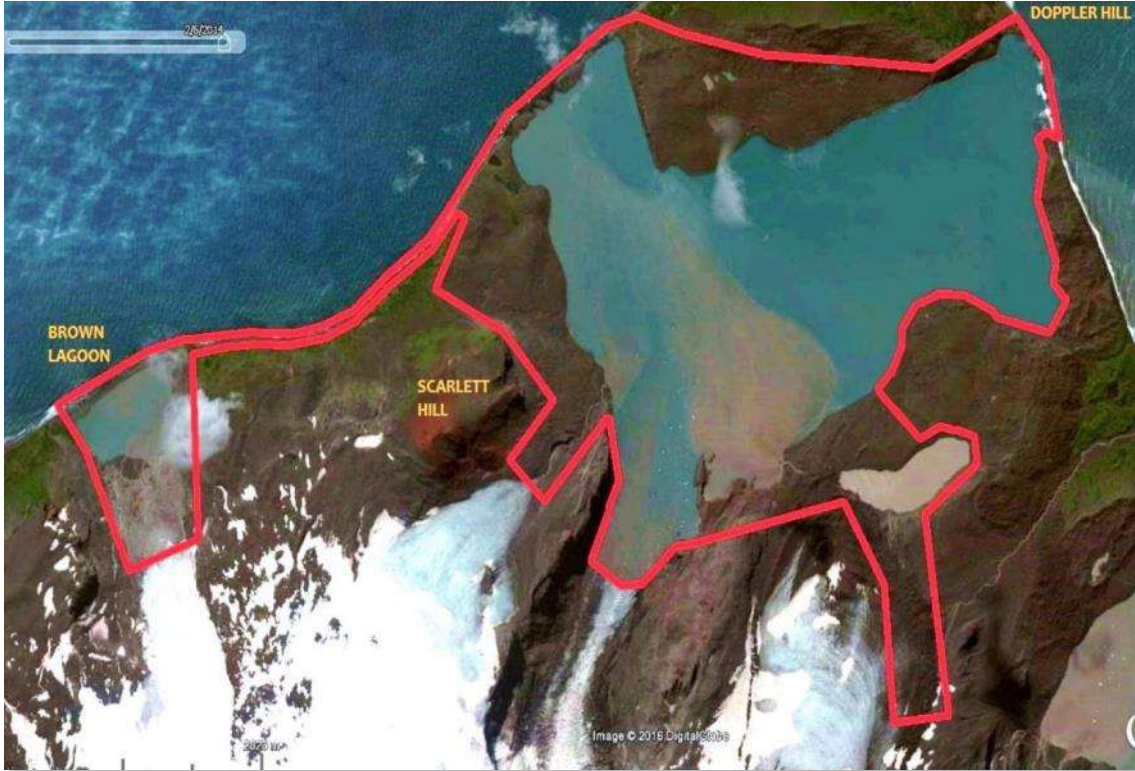


Figure 546 – Permitted areas for specimen collection within the Stephenson Lagoon and vicinity

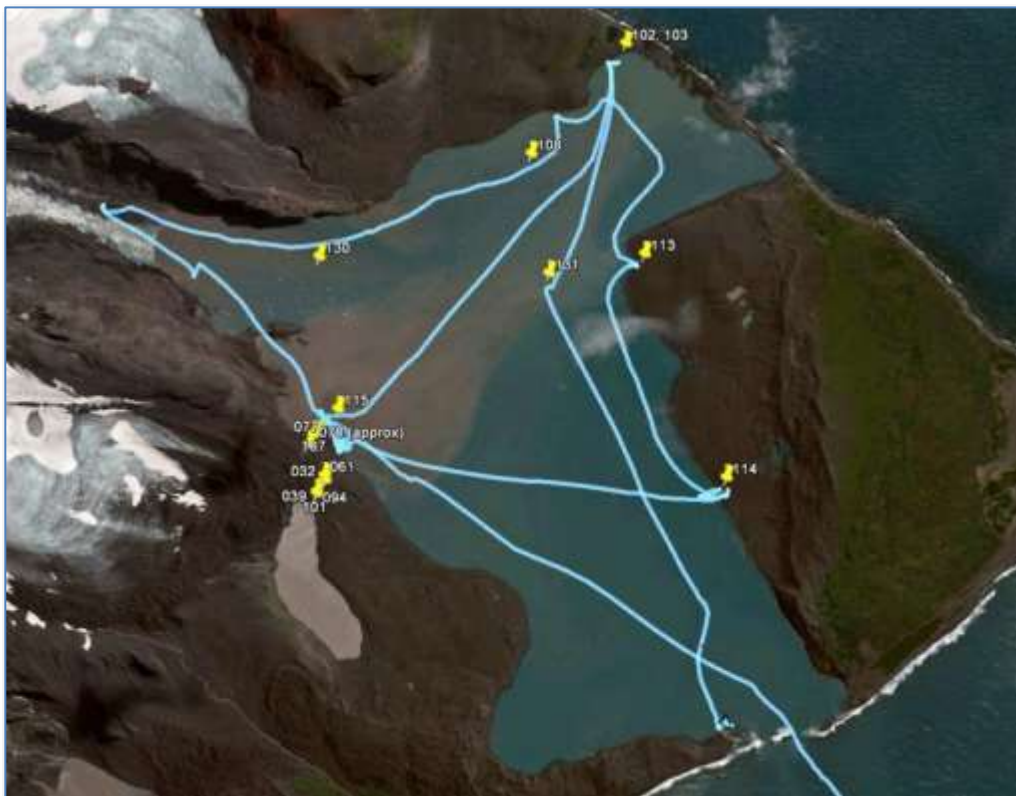


Figure 547 – Actual locations of specimen collection, and the track of the service boat on 5 April 2016. The track is the GPS data. Markers were added using the coordinates of collection locations.

The following diagram shows the locations of the logged positions during the exploration of Stephenson Lagoon on 5 April 2016. The track was recorded using a Garmin 62s GPS tracker and read out using the software GPS Track Editor. The local times (1015, etc.) are the start times for each track segment; they were obtained from the metadata attached to the digital photographs.

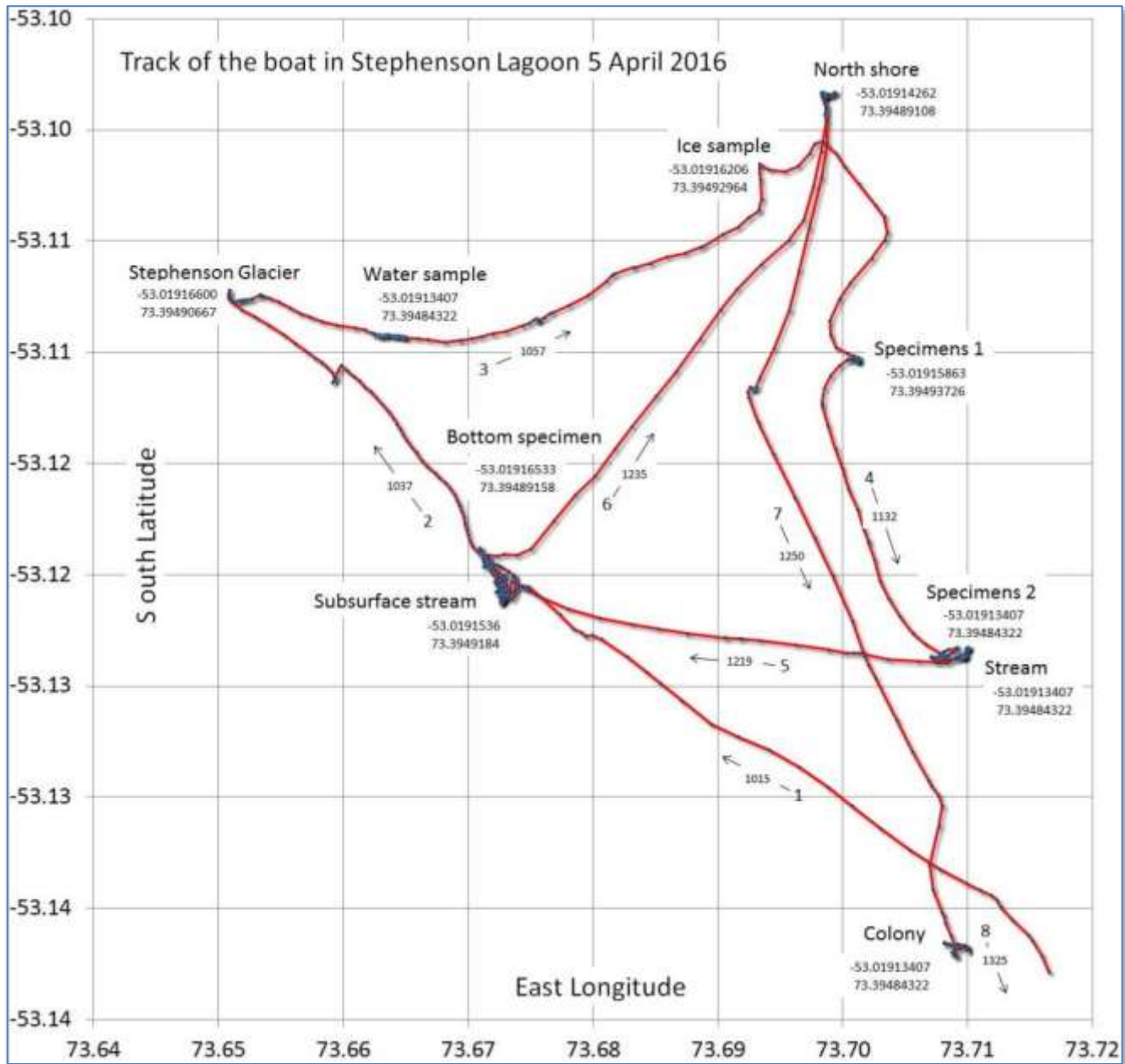


Figure 548 – Track of the visit to Stephenson Lagoon, including the coordinates of the stops for documentation and specimen collection

All specimens were initially placed in Ziploc bags and labelled with a sequential number, which was recorded by Fred Belton in a cumulative master list. On the vessel, the specimens were kept outside on deck to keep them cool. After leaving Heard Island but before arriving in Fremantle, the specimens were re-labelled and triple bagged in Ziploc bags. They were sorted into rocks (2 buckets), soil/sediment (1 bucket), and water (1 bucket).

Handling of the specimens

Upon arrival at Fremantle, the collection was examined by MS. Rhonda Bartley, the representative of the AAD, and approved for retention and distribution by Cordell Expeditions.



Figure 549 – The collection of specimens



Figure 550 – Sealing the containers after approval

The collection was divided into three sets: two buckets of rocks, one bucket of soil/sediment, and one bucket of water samples. The rock specimens were shipped directly to Jodi Fox, Geology Department, University of Tasmania. The soil/sediment and water samples were shipped to the U. S. Geological Survey, Menlo Park, California, under the permit shown here, and subsequently transferred to Cordell Expeditions under the control of the Expedition Leader.

The following table makes a comparison of the specimen collection proposals with the actual collections.

Project #	Title	# Items		Volume [Weight [kg]	
		Proposal	Actual	Proposal	Actual	Proposal	Actual
1	VOLCANISM	20	35	4	10	40	15
2	GLACIERS	40	1	2	0	6	0
3	STREAMS	100	10	2	3	1	3
4	IMMIGRATION	50	0	5	0	8	0
5	COLONIZERS	20	0	4	10	0	6
6	DIVERSITY	40	21	3	5	7	5
7	DEBRIS	30	1	30	0	15	0
Totals		310	68	50	16	85	21

The following table makes a comparison of the proposed specimen types with the actual collections.

Description	Weight [kg]	
	AAD Permit	Actual collection
Rocks	50	20
Water	15	5
Soil	10	1
Sediment	10	10
Debris	10	0
Totals	95	36

The soil/sediment specimens were washed in reagent-grade ETOH and air-dried for 3 days. Some samples were divided into approximately equal portions, one of which was tumbled for 12 hours to enable weakly adhering clumps to break apart. cursory examination showed that there was little, if any, reduction in particle size from the tumbling. The dried samples were then passed through a set of calibrated sieves: **5** (4.00 mm), **10** (2.00 mm), **35** (0.60 mm), **60** (0.250 mm), **120** (0.125 mm), and **230** (0.063 mm). Fines passing through the last sieve were collected as the 7th fraction. The various fractions were placed in individual glass bottles, and a unique label (e.g., **CE-S114-15**) containing a unique ID number and the date/location of the collection. The letters CE refer to Cordell Expeditions, while the letters R, S, W refer to Rock, Soil or Sediment, and Water, respectively. Fractional samples derived from the primary samples are given a new ID number, e.g., a fraction taken from CE-S114-15 might be given CE-S114-38.



Figure 551 – Preliminary identification of the sediment



Figure 552 – Mixing and reducing the sediment



Figure 553 – Sieving fractions



Figure 554 – Standard label attached to specimens



Figure 555 – Labeling the specimens



Figure 556 – Preliminary classification of grains

List

The following is a complete list of all the specimens collected at Heard Island during the 2016 expedition.

HEARD ISLAND 2016 SPECIMENS

#	Specimen type	Latitude S	Longitude E	Notes
002	rock	52° 59.209'	73° 17.736'	Laurens loose rock
007	water	52° 59.237'	73° 17.870'	Laurens
008	rock	52° 59.470'	73° 18.000'	small fragments of unusual appearance, "white shards", Laurens Peninsula
009	rock	53° 01.826'	73° 22.863'	collected 3/25 at 1604
010	beach debris	unknown	unknown	possible transmitter from weather balloon
012	rock/sand	unknown	unknown	collected 3/28 by Bob midway on Corinthian Bay
013	beach debris	unknown	unknown	collected by Bob open area of Nullabor
023	water	52° 58.835'	73° 19.027'	Laurens
024	rock	52° 59.402'	73° 17.337'	Laurens 402m on Mt Dixon
026	rock	52° 50.133'	73° 17.627'	Laurens
027	water	52° 59.105'	73° 18.140'	Laurens
028	soil	53° 02.406'	73° 24.124'	collected 3/28 1140 184m
029	rock	53° 02.205'	73° 23.829'	collected 3/28 at 1031
030	soil	53° 02.373'	73° 24.357'	collected 3/27 at 1031
031	soil	52° 58.722'	73° 18.577'	near apple shelter Laurens Peninsula
032	rock	53° 07.398'	73° 40.273'	
033	water	52° 59.272'	73° 17.782'	Laurens
034	soil	52° 59.276'	73° 17.697'	Laurens
035	rock	52° 59.410'	73° 17.439'	Laurens 379m on Mt Dixon
039	rock	53° 07.438'	73° 40.223'	
040	rock	52° 58.669'	73° 19.347'	Laurens
041	water	53° 01.801'	73° 24.899'	collected 3/27 at 1419
042	soil	53° 02.205'	73° 23.829'	collected 3/28 at 1031
043	soil	53° 01.801'	73° 24.899'	collected 3/27 at 1419
045	rock	53° 02.244'	73° 23.991'	collected 3/28 at 1322 185m
047	soil	unknown	unknown	Laurens
048	soil	53° 01.655'	73° 22.630'	collected 3/29 at 1308
049	water	53° 03.498'	73° 23.198'	collected 3/26 at 1239
050	rock	53° 02.546'	73° 22.594'	collected 3/26 at 0950
051	soil	52° 58.722'	73° 18.557'	Laurens
052	soil	52° 58.720'	73° 18.578'	Laurens
053	rock	52° 59.428	73° 18.177'	
054a	water	52° 59.457'	73° 18.168'	Laurens
054b	rock	52° 59.457'	73° 18.168'	Laurens scoria
055	rock	unknown	unknown	Laurens location undocumented
056	soil	52° 59.520'	73° 17.887'	Laurens
057	soil	52° 59.180'	73° 17.680'	Laurens
058	water	52° 59.180'	73° 17.680'	Laurens
059	soil	52° 58.980'	73° 17.818'	Laurens
060	soil	52° 58.683'	73° 17.780'	Laurens
061	rock	53° 07.382'	73° 40.267'	
062	soil	52° 58.765'	73° 18.568'	
063	soil	52° 59.402'	73° 17.337'	Laurens 402m on Mt Dixon
064	soil	52° 58.413'	73° 18.400'	
065	rock	52° 59.450'	73° 17.267'	Laurens
066	rock	unknown	unknown	Laurens
067	rock	52° 58.859'	73° 18.889'	Laurens scoria
068	rock	52° 58.777'	73° 18.730'	Laurens
069	rock	52° 58.682'	73° 17.781'	Laurens
074	soil			Glacial river Stephenson Lagoon
076	rock	53° 02.000'	73° 23.676'	collected 4/9 loose on ground Mt Drygalski
077	rock	53° 07.277'	73° 40.178'	
078	rock			Multiple bags labelled 078 contains rocks from glacial river

ID	Sample Type	Latitude	Longitude	Description
079	soil			Stephenson Lagoon soil from edge of Stephenson glacier
088	soil	53° 02.447'	73° 24.620'	Edge of Schmidt glacier
089	soil	53° 02.447'	73° 24.620'	Edge of Schmidt glacier
090	rock	53° 02.009'	73° 23.647'	collected 4/9 loose on ground Mt Drygalski
092	rock			Inclusion in block of glacial ice from Baudissin Glacier found on beach Corinthian Bay
094	rock	53° 07.443'	73° 40.223'	Rocks scooped from below water level at the large tarn near Stephenson Lagoon
095	water	53° 02.447'	73° 24.620'	Water from Schmidt glacier taken from lagoon just beside glacier
097	rock	53° 01.965'	73° 23.411'	Collected 4/9 at 1020. Two rocks collected at contact. Larger rock of the two is bedrock upon which smaller rock type is emplaced.
098	soil	52°59.262'	73° 18.105'	Laurens
099	rock	52° 59.092'	73° 18.123'	Laurens
101	water	53° 07.443'	73° 40.223'	Two water samples from large tarn at Stephenson Lagoon
102	rock	53° 05.865'	73° 41.990'	Loose rocks found on Stephenson Lagoon shore near north pass into sea
103	rock	53° 05.865'	73° 41.990'	Loose rocks found on Stephenson Lagoon shore near north pass into sea
104	ice/water	53° 01.677'	73° 25.072'	Baudissin Glacier/Corinthian Bay
105	ice/water	53° 01.677'	73° 25.072'	Baudissin Glacier/Corinthian Bay
106	rock	unknown	unknown	Loose rock from shore of Stephenson Lagoon exact location undocumented
107	water			Glacial river Stephenson Lagoon
108	water			Water melted from ice of Stephenson glacier
113	Biological	-53° 07.440'	73° 42.574'	Sample from east shore of Stephenson Lagoon Collected 4/5/16 RWS
114	Sediment	-53° 07.440'	73° 42.574'	Sample from east shore of Stephenson Lagoon Collected 4/5/16 RWS
115	Sediment	-53° 07.218'	73° 40.541'	Clamshell bottom grab sample near west shore of Stephenson Lagoon Collected 4/5/16 RWS
116	Biological	-53° 07.218'	73° 40.541'	Clamshell bottom grab sample near west shore of Stephenson Lagoon Collected 4/5/16 RWS
130	Water	53° 6.633'	73° 40.241'	Stephenson Lagoon
131	Water			Stephenson Lagoon

Rocks

Jodi Fox (University of Tasmania) provided the following preliminary identifications of the rocks in the collection. Selected items in this collection are shown on the next page.

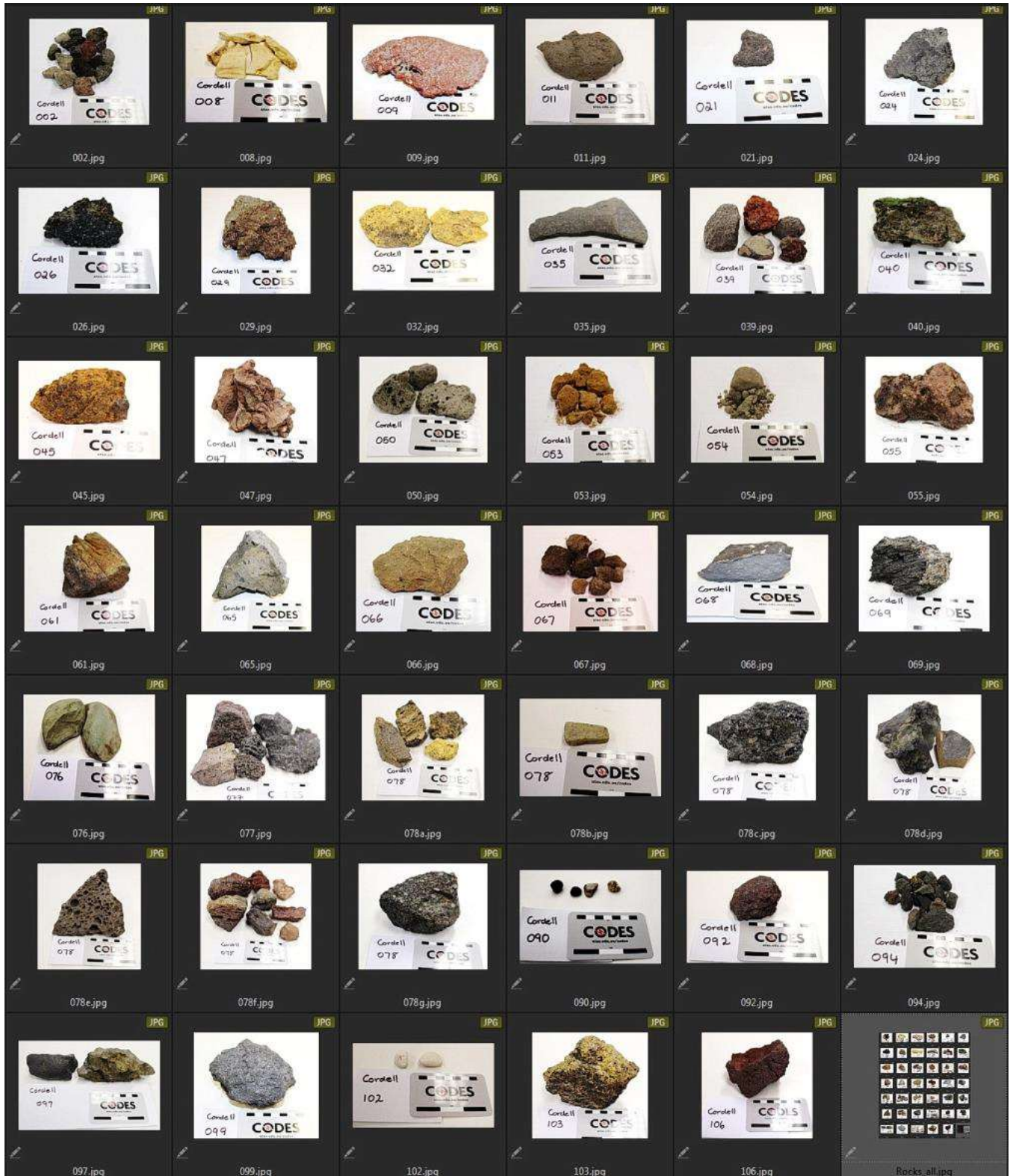


Figure 557 – The rock collection, prepared by Jodi Fox



Figure 558 – Rock specimen



Figure 559 – Rock specimen



Figure 560 – Rock specimen



Figure 561 – Rock specimen



Figure 562 – Rock specimen



Figure 563 – Rock specimen

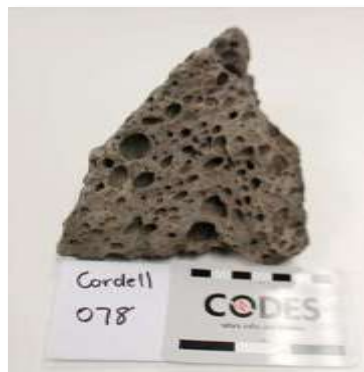


Figure 564 – Rock specimen



Figure 565 – Rock specimen

Soil/sediment

The figures on this page show micrographs of typical sediment samples. All samples on this page except the last are from fractions retained in the 35 sieve. The grid in one image is 1 mm.



Figure 566 – Sieve 35 fraction of sediment



Figure 567 – Sieve 35 fraction of sediment



Figure 568 – Sieve 35 fraction of sediment



Figure 569 – Sieve 35 fraction of sediment



Figure 570 – Sieve 35 fraction of sediment



Figure 571 – Sieve 35 fraction of sediment



Figure 572 – Sieve 35 fraction of sediment



Figure 573 – Pebbles, ca. 1 cm

Terrestrial invertebrates

On 10 April 2016 one member of the team, Arliss Thompson, noticed and collected a small insect crawling on the ground near the main campsite at Atlas Cove. The insect was walking on bare ground, at the edge of a vehicle path used to transport equipment and supplies between the camp and the beach. The path supported moderate traffic during the 3-week stay (ca. 5-10 trips/day). The specimen was alive and active when found and collected. It was placed in a glass vial, where it died after about 1 day. It lost one of its legs and assumed a retracted position. No preservative was used. The specimen is 7 mm long, and is very dark brown to black.

The following images were taken with a digital camera with a macro lens. The best images have a resolution of about 263 x 167 px.



Figure 574 – The fly collected on Heard Island •



Figure 575 - The fly collected on Heard Island

In the field the insect was thought to be an ant. However, a detailed microscopic examination showed this specimen is unambiguously identified, on morphological grounds, as the wingless fly *Anatalanta* sp. The more likely species is *A. aptera* (which is known from Heard Island), but distinguishing this from the extremely similar species *A. crozetensis* is difficult with the single specimen collected.



Figure 576 - *Anatalanta aptera* <http://www.taaf.fr/Le-patrimoine-naturel-des-Terres-australes-francaises->



Figure 577 - *Anatalanta crozetensis* http://www.aemnp.eu/pdf/51_1/51_1_217.pdf

The species list for Heard Island (Green and Woehler, 2006) includes four species of Diptera (flies), all wingless, but notably *A. crozetensis* is not on this list:

Anatalanta aptera Eaton
Calycopteryx moseleyi Eaton
Amalopteryx maritima Eaton
Tematogeton sp.

During the visit to Laurens Peninsula, Fred Belton and Gavin Marshall observed large numbers of spiders in the apple hut shelter, apparently of a single species. An attempt to photograph them was not successful and no specimens were collected. Reference to the literature indicates that only one spider is known from Heard Island, *Myro kerguelensis*. The image at right of this species was taken from Wikipedia.

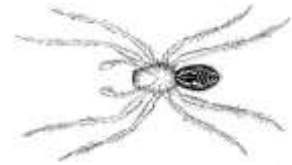


Figure 578 – Spider

Marine invertebrates

During the visit to Stephenson Lagoon, 5 April 2016, the team obtained a sample of the bottom sediment using a grab [courtesy U. S. Geological Survey]. The sample was mostly gravel, but it included several invertebrates, among which the most significant were several specimens of starfish and a single mollusc. These are shown here.

The starfish was alive and active when found and collected. It was placed in a Ziploc bag and fixed with ETOH. The specimen is 70 mm in diameter. Several much smaller specimens, apparently of the same species, were also collected. The following images were taken with a digital camera with a macro lens. This specimen is as yet unidentified.



Figure 579 – Dorsal view ●



Figure 580 – Ventral view



Figure 581 – Detail of previous image

A single specimen of a mollusc was collected in the bottom sample. The following images were taken with a digital camera with a macro lens. This specimen is as yet unidentified.



Figure 582 – Dorsal view



Figure 583 – Ventral view



Figure 584 – Detail of previous image

Plants

The majority of the soil/sediment specimens were mixed volcanic soil. However, in a few specimens there some plant debris, perhaps including seeds. These images show a mixed sample and one of the most common plants in the collection.



Figure 585 – Plant debris



Figure 586 – Single tuft of plant

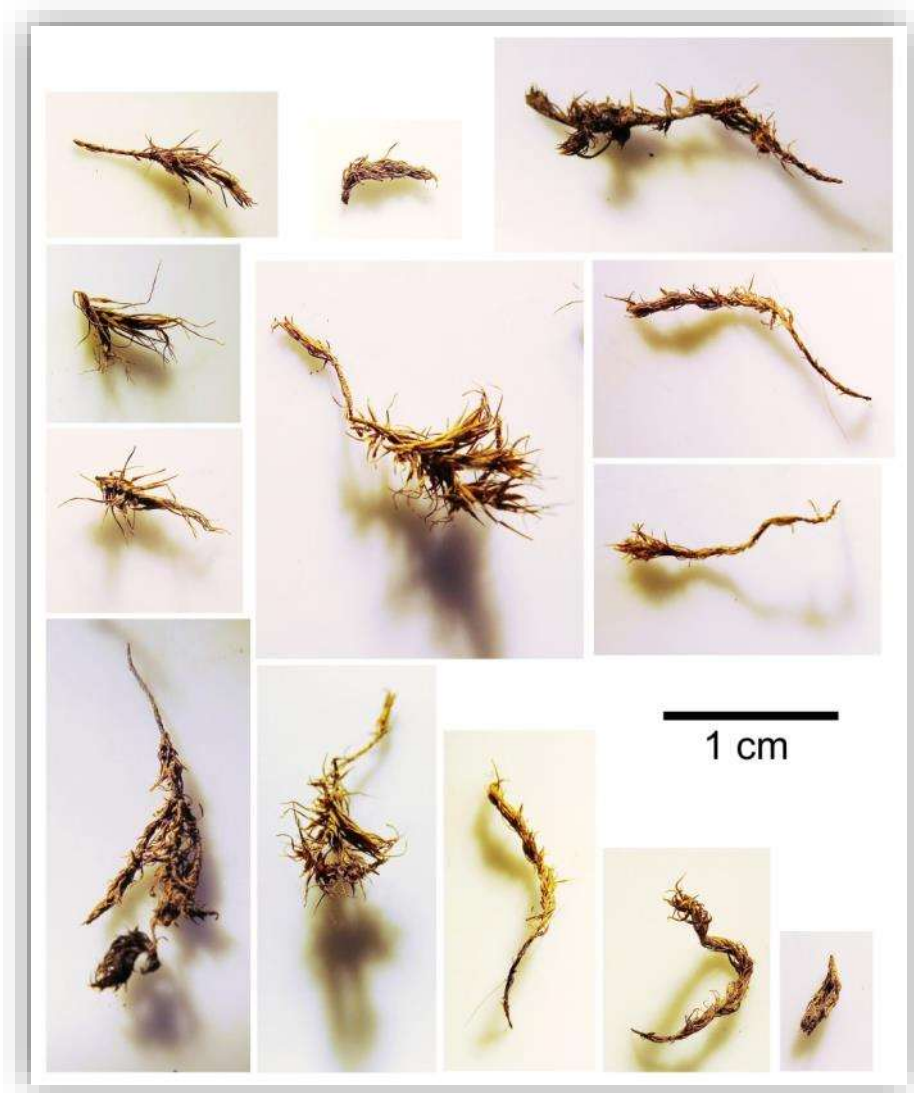


Figure 587 – Collection of tufts of the same species.

Water

The 2016 expedition team collected 12 samples of water from glacial streams, lagoons, and glacial ice in the three regions Laurens Peninsula, Nullarbor, and Stephenson Lagoon. A preliminary examination of this collection was made by measuring the pH of the samples using test strips from two manufacturers (Whatman and AZMED). The following table lists these samples and the pH measurements and averages.

Location	Specimen	Whatman Type CF paper	AZMED pH test strip	Avg	Group Avg
Laurens	7	6	5.75	5.88	5.67
	23	6.5	6	6.25	
	27	5	5.5	5.25	
	58	5	5.5	5.25	
	33	5.5	5.75	5.63	
	54A	6	5.5	5.75	
Nullarbor	41	5	5.5	5.25	5.33
	49	5.25	5.75	5.5	
	95	6	5.75	5.88	
	105	4.5	5	4.75	
Stephenson	101	5	5.5	5.25	5.63
	107	6	5.75	5.88	
	108	5	5.5	5.25	
	131	6	5.75	5.88	
Average			5.62	5.57	5.59

The plot below shows the values of the pH for these samples.

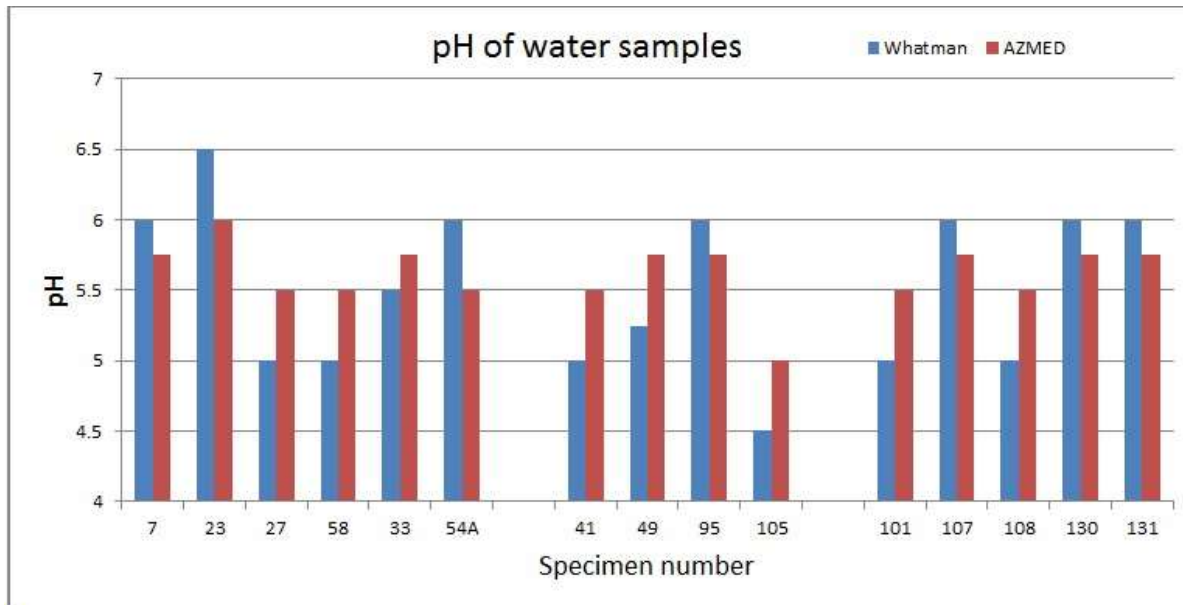


Figure 588 - pH of the 15 water samples from Heard Island. The left group of 6 is from Laurens Peninsula. The middle group of 4 is from the Nullarbor region of Atlas Cove. The right group of 5 is from Stephenson Lagoon, on the eastern tip of Heard Island. The average pH for all 15 values (both measurements) is 5.59.

The Heard Island samples all show pH values in the range 5-6, even though they are from three distinct regions. These pH values are about the same as black coffee and Pepto Bismol, but significantly higher (less acidic) than tomato juice and significantly less (more acidic) than urine and saliva. The Heard Island values are significantly lower (more acidic) than normal continental stream values.

These measurements are also consistent with the fact that most of Heard Island is volcanic rocks, while very little is calcium-rich strata such as limestone. Limestone would increase pH (make it less acidic). The average values of pH for the three groups above are 5.67 (Laurens), 5.33 (Nullarbor), and 5.63 (Stephenson). While the statistics are minimal, there is a slight indication that the Nullarbor is (slightly) the most acidic of the three regions. Whether this is due to geology or biology is not yet clear.

Additional measurements were made of the water samples, shown in the following table and plot. These measurements were made using an EXTECH ExStik EC 500 handheld meter. The quantities in the table are pH, salinity, conductivity, and total dissolved solids (Tds).

Location	Specimen	pH	Salinity [ppm]	Conductivity [mS]	Tds [ppm]
Laurens	7	6.6	85.5	185	129
	23	6.5	94	209	142
	27	5.2	5.2	185	128
	33	5.5	5.5	106	72
	54A	6.1	6.2	48	32
	58	4.8	4.8	150	104
Nullarbor	41	5.3	14.7	35	24
	49	5.9	5.9	114	79
	95 #1	5.8	21.5	46	31
	95 #2	4.9	16.8	38	18
	105 #1	4.7	61	133	92
	105 #2	4.8	176	384	265
Stephenson	101 #1	5	31.5	69	48
	101 #2	5.2	24.5	55	38
	107	5.9	5.9	58	40
	108 #1	5.3	5.4	43	29
	108 #2	5.1	5.1	47	31
	131 #1	4.6	330	706	493
	131 #2	6	168	382	263

The following plot shows how closely these parameters are correlated.

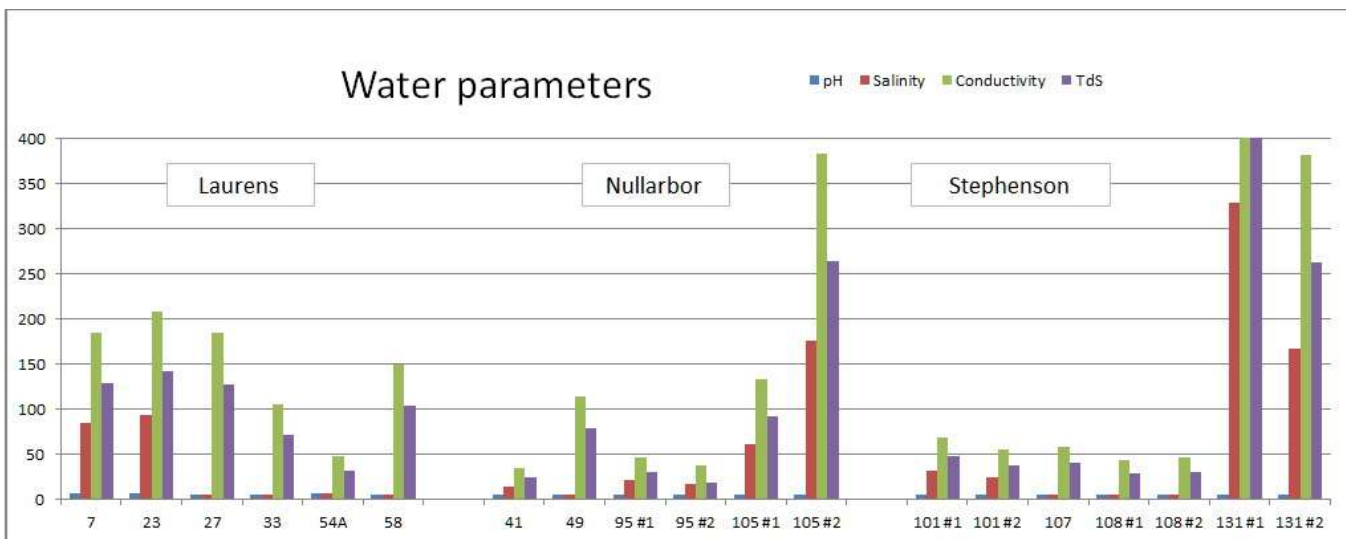


Figure 589 – Measurements of four parameters of the water specimens. The values are listed in the table above.

The standout values are for the two specimens #131, for which all the parameters (except pH) are far higher than almost all of the others. This specimen was collected in Stephenson Lagoon, and was essentially seawater, so it is not surprising that the salinity, and the other parameters, are very different from the glacial water samples.

7. INFOTECH

Overview

From the beginning, “infotech” was one of the three major components of the expedition and the larger project (field research, amateur radio, infotech). The overall goal for this component was to develop and implement techniques for connecting with persons with interest in some aspect of the project. For the three phases of the project, this essentially took the following forms:

Period	Activities
Pre-expedition	Websites (2), social media (Facebook, Twitter, <i>etc.</i>), Newsletter, online News page, Help Desk, weekly team Skype conferences
During expedition	Completely networked radio stations, DXA (real-time radio log), email, online GPS trackers, online WSPR tracker, Skype conferences (classes, interviews), personal communications, AudioLog, remote-reading weather instrumentation, online QSL and souvenir ordering
Post-expedition	Presentations, articles, reports, website updates

Some of these activities are described elsewhere in this Report (*cf.*, Outreach, Accomplishments). These activities were significantly more than any previous radio expedition (DXpedition) has ever attempted. Considerable credit goes to Co-organizer Rich Holoch, who organized the support group Diablo DXers and technically implemented most of the technology.

Help Desk

One of the innovations used on this expedition was to dispense with the traditional “pilots” for the radio operation and replace them with the Help Desk.

Over the past 30 years it became almost universal that a DXpedition would appoint a group of operators as “pilots” at various locations around the world to listen to the operations, field questions from DXers, and pass information to the team at the DX location. Unfortunately, in our opinion, this activity is ineffective. Instead, we developed the ability for anyone to log into a web site that provided direct access to a team of expedition workers who could process the issues and respond to the DXer directly and quickly.

The facility was implemented by co-Organizer Rich Holoch with FreshDesk, The software generates a “ticket” from the “customer” and passes it to the support team. The incoming tickets and responses are managed so that the customer gets a prompt response. During this project the team received and processed about 3000 tickets.

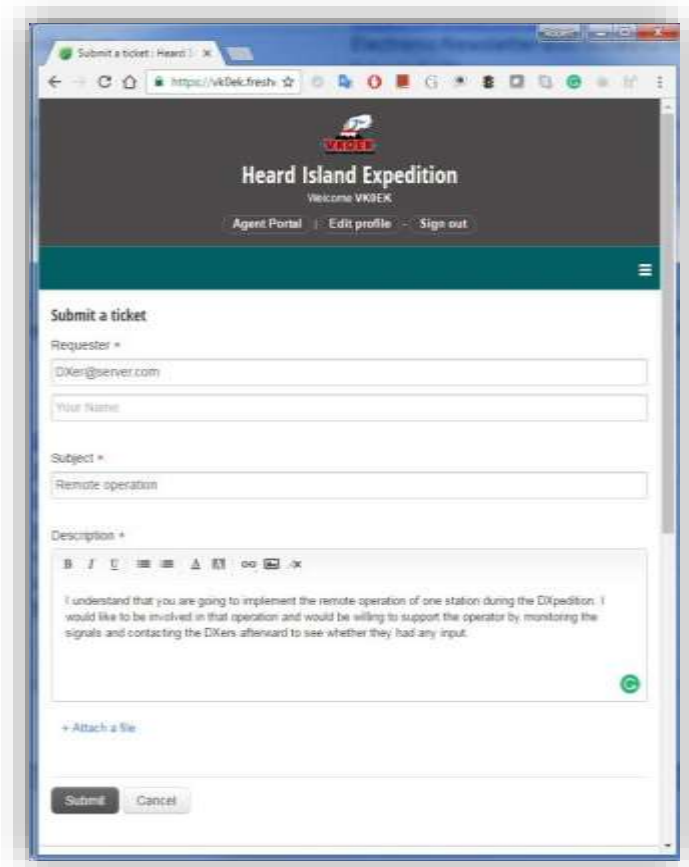


Figure 590 – The interface to the Help Desk

Skype conferences

Another innovation was the use of Skype for live video conferences with the Expedition. This was enabled by the open access to the internet with the Inmarsat BGAN terminals. Skype interviews were conducted with several individuals, including Tom Medlin W5KUB, and with classrooms in California and Ukraine. The photograph below shows the Ukraine class during a conference; the image from the expedition is seen on the monitor on the wall. This is probably the first time a classroom has had a Skype conference with a working remote expedition.



Figure 591 – A classroom in Ukraine has a 90-minute live video conference with the expedition. Arranged by Vadym Ivliev UT6UD.

While on the island, Jim Colletto used satellite communications to answer emailed questions and do video chats with several California classrooms. He also took notes on clouds in the skies above him, allowing children on America’s West Coast to learn about the atmospheric conditions above an island on the far side of the world. Students in his hometown of Tiburon, California used his adventure as a way to learn Earth science through a NASA program called S’COOL, which stands for [Students’ Cloud Observations On Line](#). S’COOL helps school children learn atmospheric science by asking them to make cloud observations to assist in validating data gathered by NASA’s CERES (Clouds and the Earth’s Radiant Energy System) set of satellite-based instruments. The Heard Island connection also gave the students a reason to learn about geography and animals, continents and oceans. The adventure shone a light on subjects ranging from science and technology to social studies. An [article on the NASA website](#) describes the activity.



Figure 592 - Jim Colletto presents to a first-grade class in Tiburon, California



Figure 593 – Making observations on the expedition [Source [NASA](#)]

Social media

Social media were another innovation that we used extensively. The presence of the Heard Island Expedition on Facebook and Twitter was a significant enhancement of the profile and support.



Figure 594 - Facebook



Figure 595 - Twitter

Websites and blogs

There are many hundreds of websites and blogs that follow a major event such as an expedition. A search will easily produce many of these. The one at left is of a Chinese website running a story on the participation of Hans-Peter Blattler HB9BXE in the radio operation VKØEK.



Figure 596 - A website story about the participation of Hans-Peter in the expedition

DXA

One of the most powerful services implemented for the Heard Island Expedition was DXA. Originally written by the author for the 2005 Kure Atoll DXpedition K7C, Pete Bourget W6OP did a complete rewrite for the 2013 Clipperton DXpedition TX5K and another (version 3) for the 2016 Heard Island expedition.

DXA is an application that accepts updates from the networked logging computers, and combines them into packets that are uploaded through the satellite connection to a server once each minute. Software on the server parses the packets and updates a database with the last 1-minute of contact information (date, time, callsign, band, mode, etc.). The front-end HTML page reads the current data in the database, and present it to the user through his browser. No manual updating of the browser is necessary—the page automatically updates each minute and is current to within about 2 minutes. DXA is documented in the book by the author (right).



Figure 597 – DXA, by KK6EK

The following image shows the (simulated) DXA web page. The display includes an equidistant azimuthal map on which is placed flags with the callsigns of the station is logged in the last minute, lists of callsigns in the log, a display of the band-modes activated by the team on the island, and a login to obtain confirmation that the DXer is in the log.

DXA was extremely popular: At any time there were typically 10,000 persons watching the webpage. More than 50,000 different people logged in to check the status of contacts.

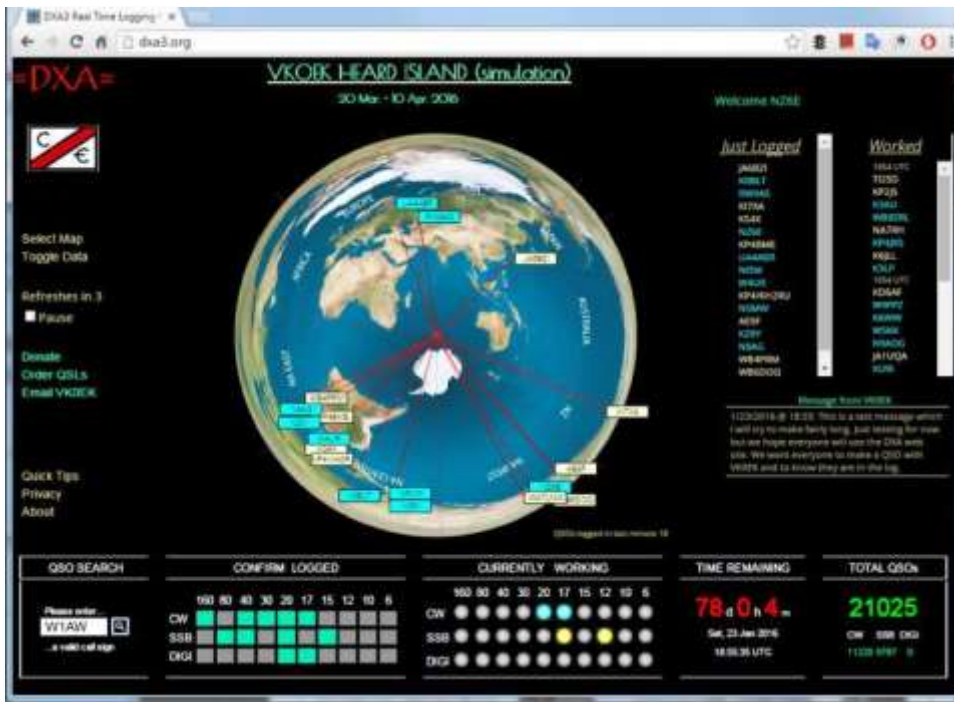


Figure 598 – The DXA web page (pre-expedition simulation)

DXA is actually not expensive to implement: Taking advantage of a data-transmission mode at a cost of about US\$7/MB, the entire VKØEK log could have been uploaded for less than \$20. For this expedition, the Inmarsat terminals were provided to the expedition at no charge. With the facility, the team was able to maintain a high level of communications on email, Skype, twitter, and other social media.

8. AMATEUR RADIO

The amateur radio operation comprised the bulk of the effort, expenditure, and funding of the 2016 expedition. It was described in the October 2016 issue of QST Magazine, which we reproduce here.

VKØEK Heard Island, by Robert W. Schmieder, KK6EK

There's a good reason why there was no radio operation from Heard Island for the past 20 years: It's arguably the most difficult destination of any DXCC entity. What makes it hard is not just its ferocious weather, nor its distance from civilization (almost 2500 miles across the Southern Ocean), nor the formidable effort of obtaining a permit to visit, nor the requirement to spend almost two months away from home, nor the near-impossibility of finding appropriate vessel transportation, nor the cost to the participants, nor the necessity to raise the total project financing, nor the requirement for Public Liability Insurance, nor the need to travel extensively to seek partners and coordinate plans, nor the extensive investment in creating and maintaining websites and other social media, nor even the need to spend more than three years of planning to put together a safe and effective team with all the tools and requirements in place. In fact, what makes it hard is all these factors, which combined together make Heard Island probably the "most difficult" DX destination in the world. It's no wonder that activations take place there only about every 20 years.

I was one of the organizers of the previous DXpedition in 1997 (VKØIR). My obsession with the island is well-documented in my book VKØIR Heard Island. But my vision of a return expedition was based on something else: no less than a major evolutionary change in how we do DXing and DXpeditions, to provide more of what DXers and DXpeditioners want and are coming to expect. My belief, described in my various expedition books, is that everyone involved wants the same thing: a successful expedition (for DXers, this principally means their call sign in the log). My 25-year strategy was to introduce new technology and techniques to provide tools to assist that effort. In 1995, the Easter Island DXpedition XRØY/Z was the first to involve the internet (*e.g.*, the online log server). Ten years later, the 2005 Kure Atoll DXpedition K7C was the first to provide real-time internet connection (DXA). And now, after another decade, I envisioned an expedition to Heard Island in which social media would provide an extensive set of new tools. All these developments were designed to provide assistance to the DXer to enhance his chances of success and to enable attracting and satisfying a new range of sponsorship for the project.

PREPARATION

After a long incubation time, in May, 2012, I announced plans to organize and lead an expedition to Heard Island. It would prove to be much harder than I imagined. My strategy included the following: (1) A multi-disciplinary project, including radio, science, and information technology. (2) Completely open planning; (3) Extensive outreach via social media; (4) Significant commercial sponsorship; and (5) The highest ethical standards, including legal and fiscal soundness, and risk management.

My first realization, and ultimately perhaps the most important, was that the radio community alone could not raise the finances for such an expedition. My solution was to combine the radio operation with two other activities: field science and advanced

communications technology. None of the three activities alone could muster sufficient support for such an ambitious project, but together they could. Automatically, inevitably, it would be multi-disciplinary.

The project would be organized with the standards I had developed and practiced over the past 35 years under my nonprofit organization Cordell Expeditions. A major boost to the project occurred when Rich Holoch KY6R enthusiastically agreed to be the co-organizer of the project. His creative contributions and extraordinary hard work would be central to the realization of project.

One of the biggest challenges was finding transportation to get to Heard Island. For various reasons, three vessels that had made pre-contractual agreements with us failed to keep their commitments, so in mid-2015 I contacted Nigel Jolly, owner-operator of Braveheart, who agreed to do the trip. In retrospect, it was the best of all possible developments.

For fundraising, we contacted all the major DX foundations and clubs, and set up a website that provided extensive information. We obtained the support of more than 100 organizations and more than 5000 individuals. HDT Global provided AirBeams (military-grade tents that erect by inflation in about 15 minutes), Inmarsat provided four BGAN satellite terminals and unlimited air time, and Disc-O-Bed provided high-quality bunks. In rough numbers, foundations and clubs contributed about \$80,000, individuals about \$100,000, corporations about \$40,000, and the team about \$280,000. Thus, the total cost was roughly a half-million dollars.

Obtaining the permit was a major effort. A lot has changed since 1997: Heard Island has been added to the World Heritage List, a major Australian scientific expedition in 2000-2003 highlighted the fragile and rapidly changing environment, and the Australian government had reduced support for Antarctic operations. I made two separate trips to the Australian Antarctic Division (AAD) in Tasmania to negotiate the permit, and I wrote hundreds of pages of detailed description and justification for the project.

All members of the team were licensed radio operators. Dave Lloyd K3EL took the major responsibility as Radio Team Leader. Arliss Thompson W7XU came in as the doctor. Two members (Gavin Marshall and Fred Belton) were experienced mountaineers and volcano explorers, and I designated them to carry out the field work. Of the 1997 VKØIR team, I was the sole survivor.

The equipment included major contributions from Elecraft, DX Engineering, Array Solutions, Spiderbeam, and many other companies. Some equipment and supplies (*e.g.*, coax) was provided by Cordell Expeditions. The cargo was consolidated in Virginia, and shipped in one 20-ft. container to Cape Town, South Africa, where it was delivered to a warehouse on the dock near Braveheart.

THE EXPEDITION

The team of 14 men converged on Cape Town the first week of March, 2016. They spent most of their time cleaning and repacking the gear. The permit from the AAD required that the cargo be



Figure 599 - QST Oct. 2016

exhaustively cleaned and inspected, and the vessel be inspected for rats and possible infestation by insects, seeds, spores, and fungus. Anticipating the need for a vehicle to move the cargo on the island, I purchased an All-Terrain-Vehicle (ATV) and it was loaded with everything else aboard the vessel.

We sailed from Cape Town aboard *Braveheart* on March 11, 2016. The voyage was long, but we were very active on the radio, and we deployed a series of scientific buoys provided by NOAA and the Woods Hole Institute. After a 12-day voyage, we arrived at Heard Island and were greeted with the extraordinary sight of Big Ben, the 9000-ft. live volcano dominating the island. Our long lenses captured images of the smoking crater near the peak, but we didn't see any streaming lava. We made a quick reconnaissance trip to the planned site for our camp, near the ruins of the 1947 Australian research station (ANARE), but we found it to be unsatisfactory for our AirBeam tents.

Early the next day, the team found a perfect campsite: a 20x60 ft. flat area about a quarter mile from the beach. Within an hour the ATV began delivering our gear, and by mid-morning the tents were up. Several four-square vertical array antennas were erected on flat ground in front of the camp, and several Yagi antennas were put on the elevated rocks around the camp. Within 15 hours of landing, we had several stations completed, and we activated VKØEK. To our great surprise, we heard not a single SSB station, a pattern that was to be frustratingly common during our entire stay. CW it was, then, and thereafter. Within 48 hours of landing we had 6 operational stations.

The BGAN satellite terminals provided direct access to the internet. This meant that we could use our special software, DXA, to provide real-time online confirmation of QSOs. Once each minute it uploaded the log updates, and anyone with a browser anywhere in the world could get confirmation of his QSO within 2 minutes of making it. Almost always there were 10,000 people watching DXA. We also used the BGANs for email, Skype interviews, and for personal and expedition business.

By the third day we fell into a routine: The ops worked the pileups, and the field team explored the area around Atlas Cove, making extended treks to document the plants, animals, glaciers, and the trash that accumulates from the ocean. The crew from *Braveheart* brought gasoline, water, food, clean kitchenware, and laundry, usually around noon. One day we carried out the first ever remote radio operation. I spent considerable time handling email and filing required daily reports to the AAD. Outside, the temperature was around zero centigrade, but the wind chilled it to much lower, and we found it difficult to be outside for much longer than required to service the generators and go to the bathroom.

On April 4, three of the team (Gavin, Fred, and myself) were taken on *Braveheart* to the opposite end of the island, 20 miles from Atlas Cove, to inspect the area around Spit Bay and to explore the recently created Stephenson Lagoon. We had thought that Spit Bay area might help with propagation to the North America west coast, but we were quickly dissuaded from that: the surf was unworkable. In fact, the radio log actually showed that the operation was unnecessary. We did have a brief weather window, and we burst through the high surf to enter the 2-mile-wide lagoon. For 3 hours

we excitedly documented what we found with photographs and specimens. It was a “lost continent” experience: we were the first people to observe and document the changes due to global warming.

COMPLETION

Near the end of our stay, propagation dwindled to somewhere between terrible and none. On April 11, we had a short window of reasonable weather, and it was decided to strike camp and leave. Good thing—as we were departing, a front arrived that almost certainly would have stranded us on the island for another week at least. The voyage from Heard Island to Fremantle, Western Australia, was another 11 days. We mostly spent the time resting and watching the ocean, but we did continue to work DXers maritime mobile and we deployed another set of scientific buoys.

We arrived in Fremantle early on April 22, and were greeted by customs, immigration, and biosecurity officials, as well as a representative from the AAD, who flew over from Tasmania specifically to look at our specimens. Apparently she was satisfied, and we hammered the lids on the buckets and prepared to ship them. The rocks went to the University of Tasmania and the water and soil samples came to me in California, to be distributed to specialists in museums and universities. The next day the Northern Corridor DX Group threw us a celebratory BBQ, and we began to prepare to disperse.

My transition back to civilization was moderated by two delightful days in Sydney with Grahame Budd, the legendary explorer of Heard Island. Grahame was the first to summit Big Ben (in 1965, done only twice since), and is probably the world's living authority on the island. We toasted the current project with a 50-year-old whiskey from his summiting expedition.

RETROSPECTION

So has this project changed DXing, as we hoped? I think, *potentially*, yes. I claim that the first three initiating events were: (1) Introduction of the Internet (XRØY/Z, 1995); (2) Implementation of real-time (K7C, 2005); and (3) Extensive use of social media (VKØEK, 2016). What's next? I believe it will be “Systems integration.” This could include remote operation, software-defined radio, adaptive signal processing, automatic logging, integrated station operation, signal optimization, cooperative activities, new digital modes, and other techniques. Clearly, there is plenty of richness for another major step forward. I believe this step will inevitably happen, so long as DXing and DXpeditions exist.

Disappointments? I have a few. The weather and duties prevented me from doing much of the exploration I had dreamed of for 20 years, and as I left I was pensive, knowing that I would probably never again see this island I had come to know and love. But the satisfaction of a successful project, the pride and admiration I have in the superb team, the appreciation to the sponsors for making it financially feasible, the anticipation of potential discoveries in the specimens ... these moderate the disappointments. And to be honest, I know that, in spite of the difficulties and criticism and frustration and disappointments, we delivered a successful and significant project, as promised, and that is a source of pride for all who can say “I helped make it happen.”

On the team, two members were assigned exclusively to field science, with several others supporting that activity, principally by photo-documentation. Thus the radio operators comprised 85% of the team and around 80% of the non-overhead work during the stay on Heard Island. The funding was about 80% from the amateur radio community, and about 20% from sources supporting the scientific and infotech effort. Thus, the balance between operations and support was quite consistent.

Statistics of the VKØEK operation

The following data show the basic distributions of QSOs (contacts) logged by VKØEK. Of the total 75,034 QSOs, there were 21,220 different callsigns and 174 DXCC entities.

Number of QSOs vs time

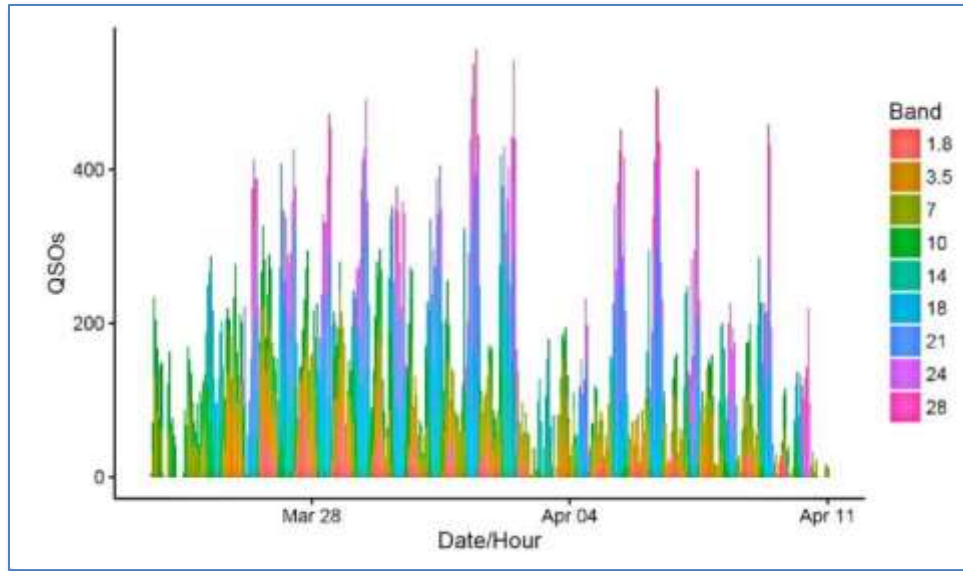


Figure 600 – Numbers of QSOs for all bands vs time over the course of the operation

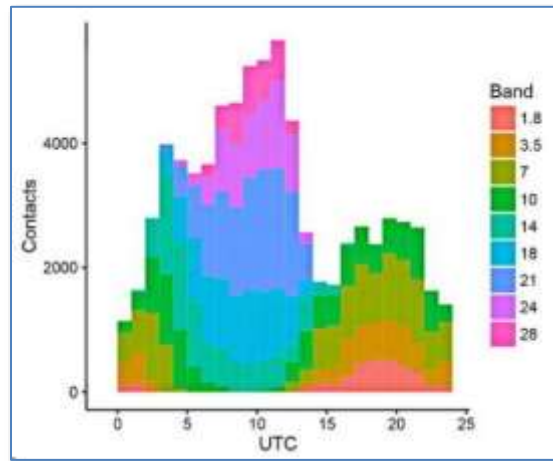


Figure 601 – Average numbers of QSO/hr over all 24-hour cycles

Several aspects of these data show the effects of the propagation. The most obvious of course is the diurnal (daily) cycle as the path moves into and out of daylight. The distribution of QSOs vs frequency shows why the bands 15-40 m are the most useful. The peak rate was around 1000-1200 UTC, and there were two minima, around 1500 UTC and 0000 UTC. What is less obvious is the reduction in rate around April 4 and April 8-11. These periods were not deficient because of lack of effort--the team was active on all bands and modes and all day/night. Unfortunately the propagation declined during the this week (see below).

Number of QSOs by band and mode

MHz	CW	RTTY	SSB	QSOs	%
1.8	3225	0	13	3238	4.3
3.5	5902	0	0	5902	7.9
7	8956	1279	1562	11797	15.7
10	9898	933	0	10831	14.4
14	5774	0	3238	9012	12.0
18	7047	0	2957	10004	13.3
21	7643	1183	4498	13324	17.8
24	5015	0	2342	7357	9.8
28	2419	1	1149	3569	4.8
Total	55879	3396	15759	75034	

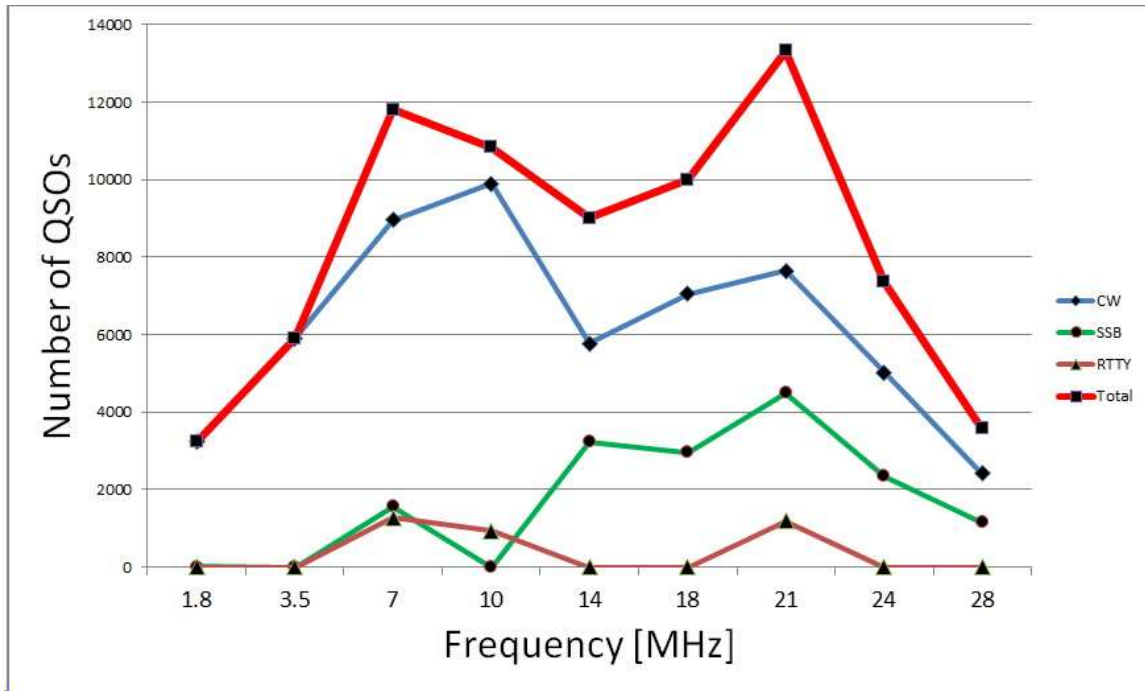


Figure 602603 – Number of QSOs vs band and mode

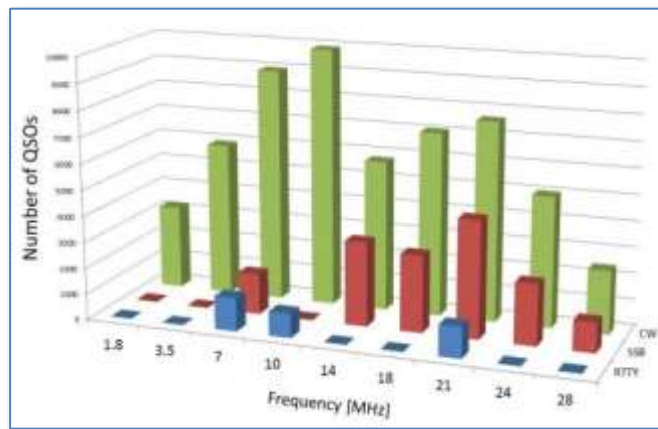


Figure 604 – Number of QSOs vs band and mode

Number of QSOs by band and continent

MHz	AF	AS	EU	NA	OC	SA	UNK
1.8	24	483	2376	293	56	6	0
3.5	50	922	3410	1383	104	31	2
7	132	1789	6420	3205	167	81	3
10	63	1488	4807	4165	211	94	3
14	207	2160	3268	2680	628	68	1
18	153	3508	4842	952	383	153	13
21	206	3315	7789	1344	353	316	1
24	98	2285	4308	475	112	76	3
28	48	1126	2277	82	29	6	1
CW	456	12221	30626	10901	1097	554	24
RTTY	36	663	1389	1182	71	54	1
SSB	489	4192	7482	2496	875	223	2
QSOs	981	17076	39497	14579	2043	831	27
%	1.3	22.8	52.6	19.4	2.7	1.1	0.0

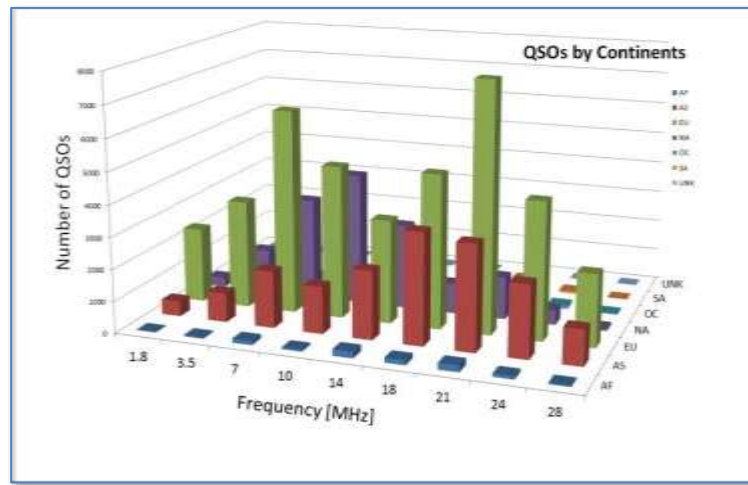


Figure 605 – Number of QSOs vs band and continent

Propagation

All solar and geomagnetic indicators declined again last week. Compared to the previous seven days, from March 31 through April 6 the average daily sunspot number slipped from 28.1 to 19.4. Average daily solar flux sank from 88.8 to 83.1, while average daily planetary A index went from 11.9 to 9.4. Average daily mid-latitude A index went to 7.6 from 8.6. The big factor in bringing the week's average sunspot number down nearly 9 points was the fact that the daily sunspot number was 11 on March 31 through April 2. 11 is the lowest sunspot number we can possibly observe, unless there are 0 sunspots, then the sunspot number is 0. Each sunspot group is counted as 10 points, and these are added to the total number of sunspots which count as one each, so a sunspot number of 11 is what you get with just one sunspot visible.

Early on April 8 at 0007 UTC the Australia's Space Weather Services issued a geomagnetic warning:

"The geomagnetic conditions are currently at minor storm levels and are expected to remain at these levels for the next 6-12 hours. This is a combined effect of sustained strongly southwards IMF Bz (see <http://bit.ly/1S6H68D>) starting from 07/1800 UTC but with stable, weak solar wind speeds (380 km/s). However, the solar winds are expected to gradually increase later today in response to a small recurrent southern hemisphere coronal hole moving into a geo-effective location on the solar disk. The aurora may be visible from as low as some parts of the state of Victoria, Australia, on the local night of 8 April. Increased geomagnetic activity expected due to a coronal hole high speed wind stream from 08-09 April 2016."

Sunspot numbers for March 31 through April 6 were 11, 11, 11, 38, 23, 27, and 13, with a mean of 19.1. 10.7 cm flux was 81.7, 82.1, 81.5, 82.3, 83.4, 83.4, and 87.1, with a mean of 83.1. Estimated planetary A indices were 7, 3, 22, 15, 7, 5, and 7, with a mean of 9.4. Estimated mid-latitude A indices were 5, 2, 15, 13, 6, 5, and 7, with a mean of 7.6.

[Source: ARRL Propagation Forecast Bulletin 15 ARLP015, prepared by Tad Cook, K7RA, Seattle, WA 8 April 2016 (<http://www.arrl.org/w1aw-bulletins-archive/ARLP015/2016>)

9. ENVIRONMENTAL DATA

NOAA drifters

During the cruise five NOAA drifters were deployed by team member Adam Brown:

Number	Day deployed	Date deployed	Latitude [°N]	Longitude [°E]
145799	13591.53	March 19 00:46:04.8 UT Saturday	-49.376	41.987
145780	13593.09	March 20 14:09:36.0 UT Sunday	-50.126	51.996
145774	13593.73	March 21 05:31:12.0 UT Monday	-50.712	55.997
125789	13594.64	March 22 03:20:09.6 UT Tuesday	-52.142	61.004
145782	13595.20	March 22 16:48:00.0 UT Tuesday	-52.451	64.984

In this table, the time is [days since 1/1/1979 0000 UTC] Thus 13593.73 = 2016-Mar-19 1731 UTC. An [online conversion routine](#) provided by the U.S. Navy was used to compute the dates from the day numbers. The locations and temperature data were obtained from NOAA [\[source\]](#) [courtesy, Rick Lumpkin, NOAA]. The data is inclusive to early October, 2016.

The trajectories of the five drifters are shown in the following figure

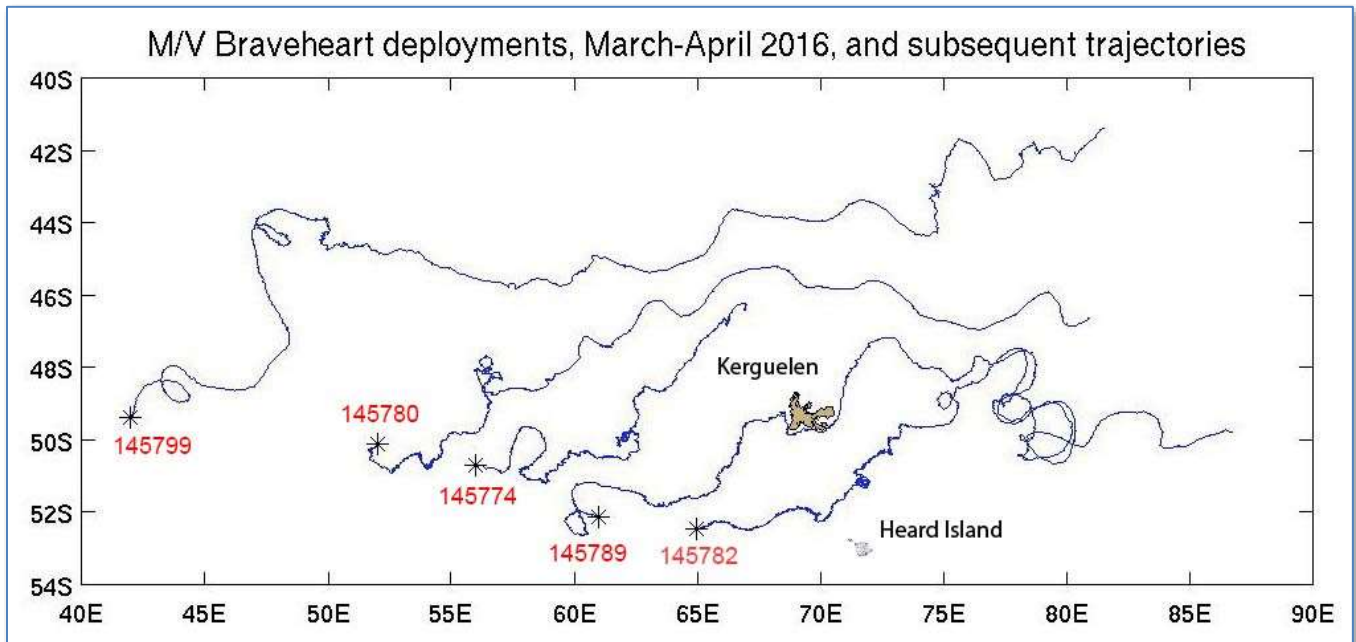


Figure 606 – Trajectories of the NOAA drifters deployed on the outbound cruise

The trajectories show a variety of interesting features:

- Generally the drift is eastward, but every unit moves north at a very rough rate of about 1°N/5°E.
- Loops are common, Three trajectories show localized “knots” where the drifter moved very little
- Drifter 145789 approached Kerguelen Island but was not stranded; it went around to the south
- Two drifters (145789, 145782) converged on the same large area
- Drifter 145780 shows a series of roughly equally spaced peaks, *etc*, northward excursions

Some of these features will be shown in more detail on the following pages.

Drifter 145782 was relatively becalmed for about 18 days (24 May – 11 June 2016), during which it circulated in a series of (counter-clockwise) loops within an area about 30 km in diameter.

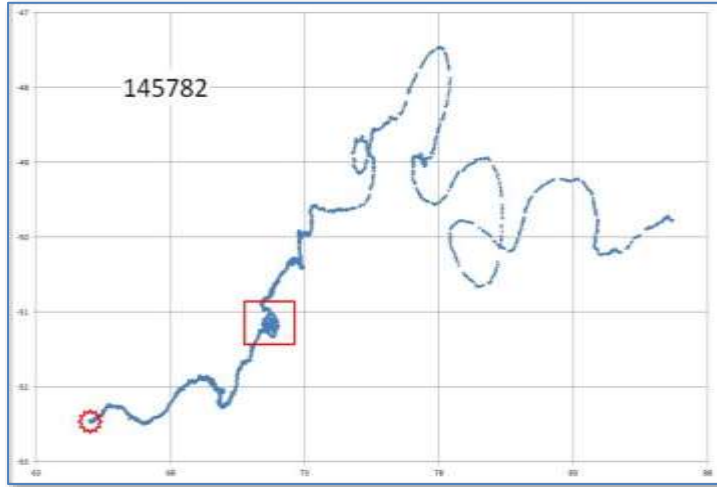


Figure 607 – The track of drifter 145782

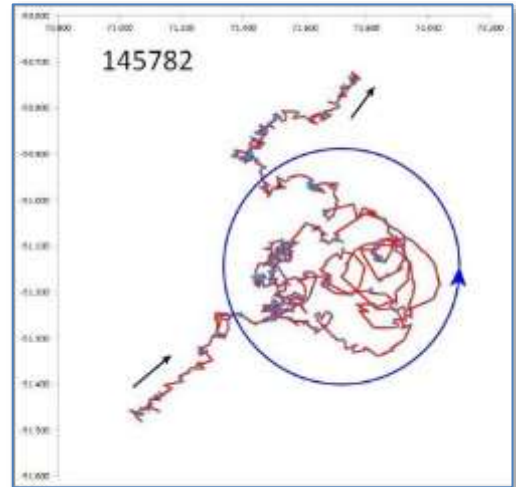


Figure 608 – Detail of track of drifter 145782

Drifter 145789 moved directly toward Kerguelen Island, but was deflected to the south and went around.

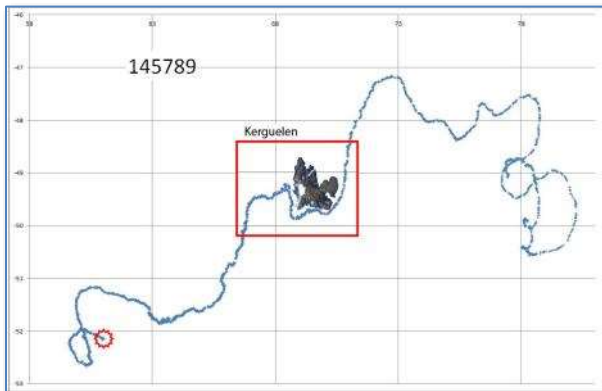


Figure 609 – The track of drifter 145789

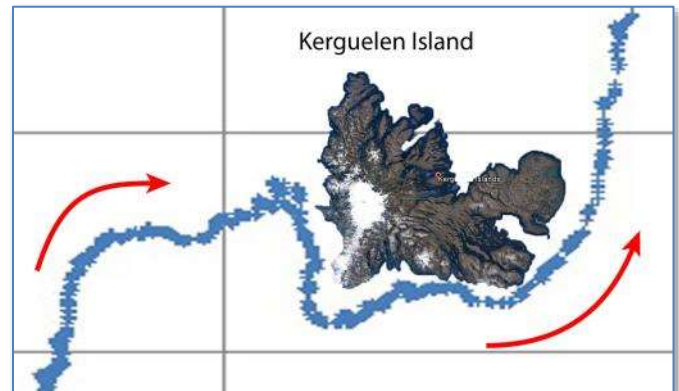


Figure 610 – The encounter of 145789 with Kerguelen Island

Two drifters showed rather large (10-30 km) swings north while continuing their eastward drift.

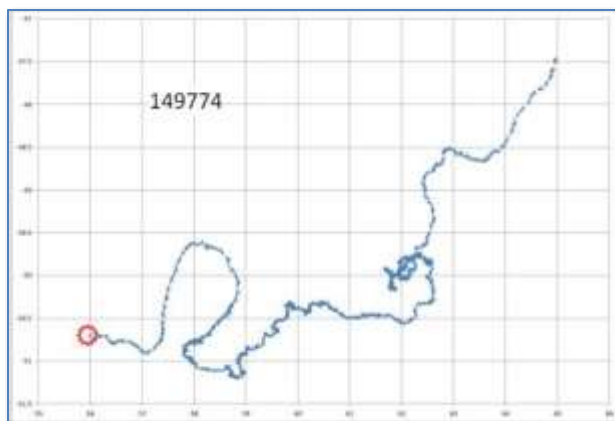


Figure 611 The track of drifter 149774

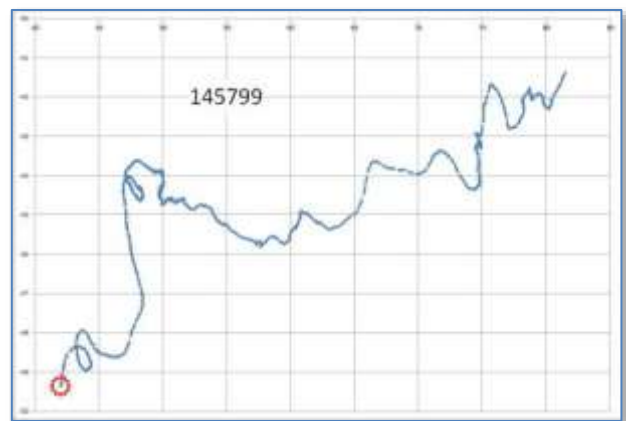


Figure 612 – The track of drifter 145799

Drifter 145280 followed a rather systematic track, unlike most other drifters that were chaotic. As shown in the figure below (left), it moved along a fairly smooth arcing trajectory, going north for about 600 km and then swinging east and toward the south again. But the most interesting features are the series of northward peaks, each about 1° Latitude, or about 110 km, superposed on the slow trajectory. We can see perhaps 8 of these peaks over the course of the drift (about 150 days), so the period is approximately $150/7 = 20$ days.

The figure below (right) shows a detail on this trajectory, and the following two figures show details on this detail. The figure lower-left shows about 8 counterclockwise loops (the drifter enters from the top and exits from the bottom of the diagram). The figure lower-right shows 4 narrow counterclockwise loops with rather sharp reversals. The average period for these loops is about 10 days.

The fact that many (but not all) the observed small circular motions are counterclockwise probably is significant. In the southern hemisphere, large-scale cyclonic winds are clockwise. A large storm might be expected to shed numerous smaller counter-rotating (=counterclockwise) vortices.

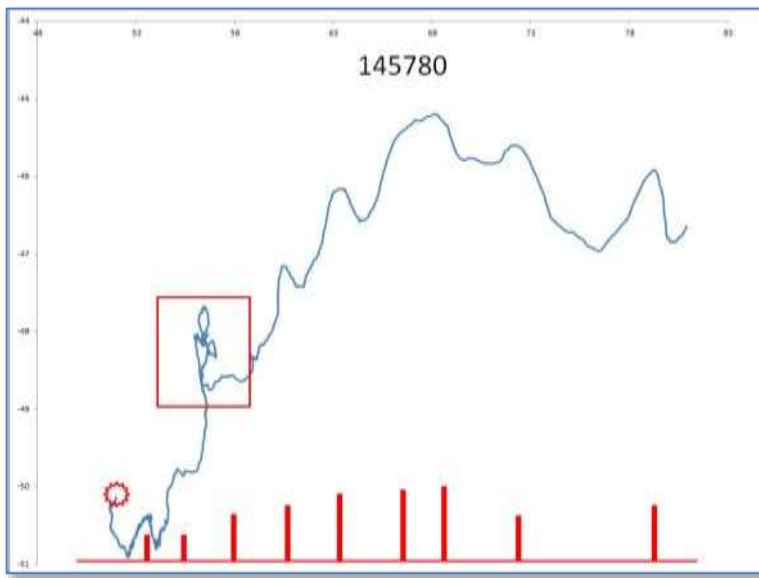


Figure 613 – Drifter 145780. The markers highlight the N-Sexcursions

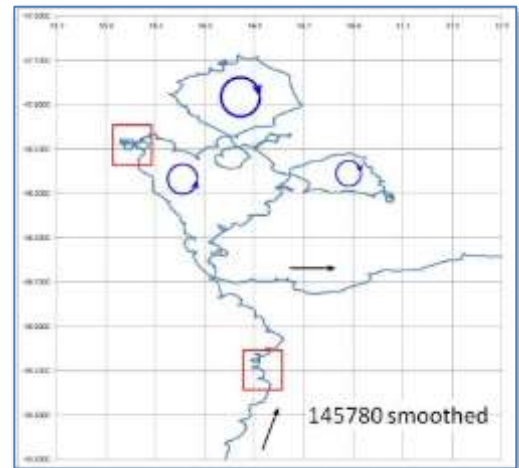


Figure 614 – Detail of drifter 145780

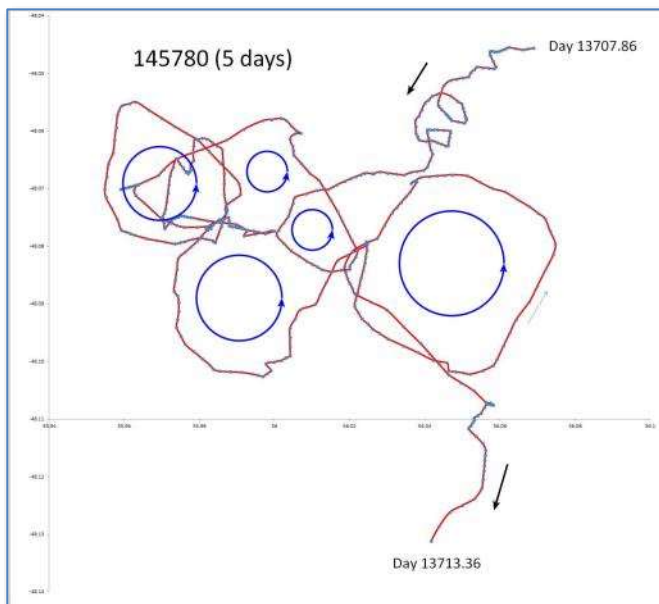


Figure 615 – Detail of drifter 145780

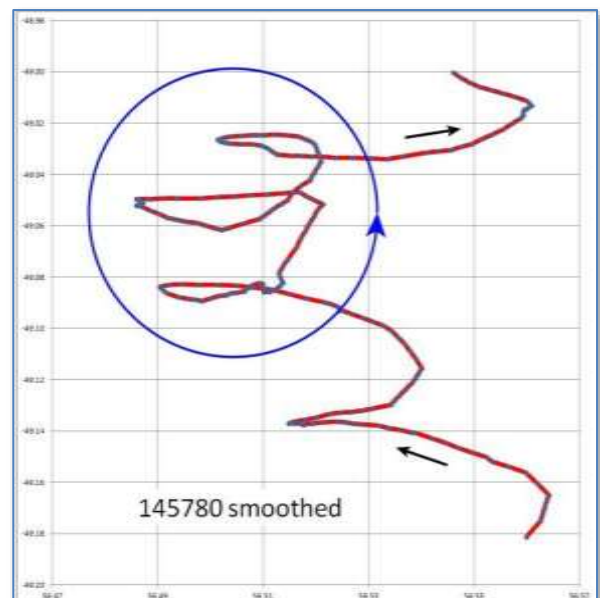


Figure 616 – Another detail of drifter 145780

The NOAA drifters record the temperature as well as position. The following diagram shows the trajectories with color-coded temperatures. The obvious decrease of temperature with increasing (southern) Latitude is modified by the mesoscale fluctuations, probably indicating mesoscale-scale eddies.

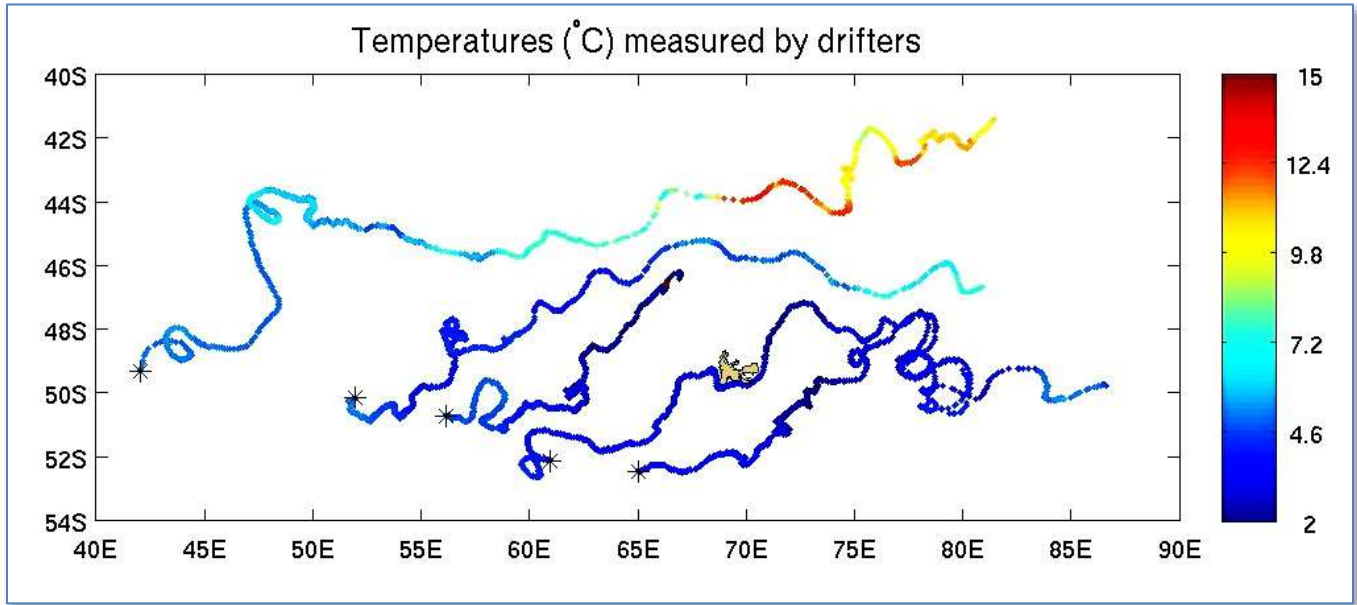


Figure 617 – Temperature measured by the 5 drifters

Individual temperature records as a function of time for two drifters are shown in the following figures.

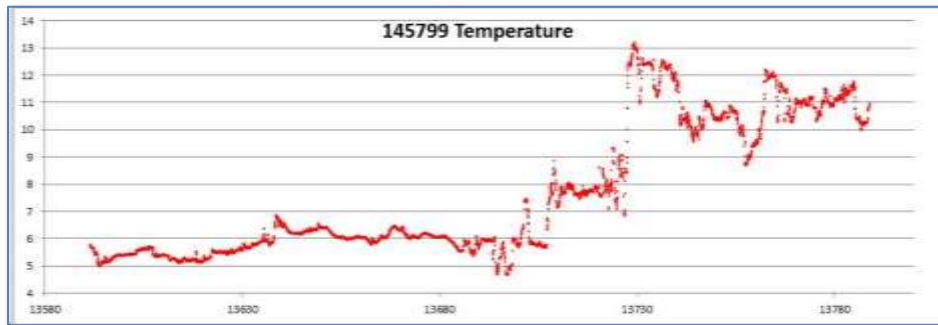


Figure 618 - Temperature measured by drifter 145799



Figure 619 – Temperature measured by drifter 145782

WHOI diving buoys

During the cruise we deployed the following buoys

Number	Metadata		Date deployed		Latitude	Longitude
					°N	°E
7321	6477_007321.meta	1901810	2016- 3-14	2457462	-43.30	25
7325	6479_007325.meta	1901812	2016- 3-15	2457464	-47.4	32
7323	6478_007323.meta	1901811	2016- 3-18	2457466	-50.0	47
7320	6476_007320.meta	1901809	2016- 3-19	2457468	-50.9	57
7327	6480_007327.meta	1901813	2016- 3-19	2457467	-50.4	54

Typical data for one of these buoys is shown in the following two figures. The entire cumulative data from all the buoys are available from the ARGO data website [Source: http://argo.who.edu/DMQC/launch_meta.html].

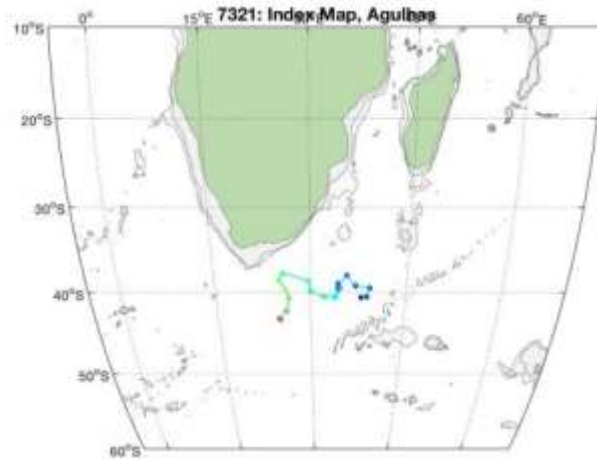


Figure 620 – Trajectory of buoy 7321

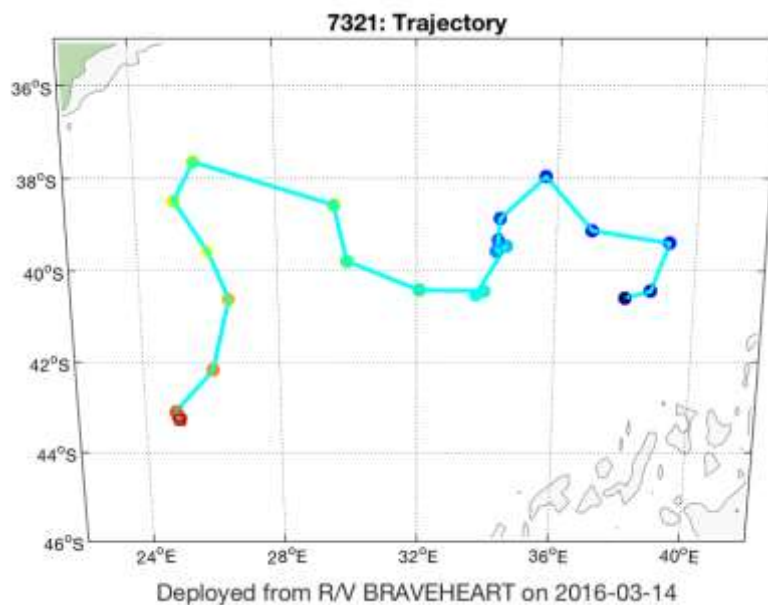


Figure 621 - Trajectory of buoy 7321 (detail)

The buoys progressed through a series of descent-ascend cycles, shown in the figure at right. The surface is at the top of the figure, and the black line is the topography along the trajectory. Thus, this particular buoy (7321) went through 6 cycles of increasing maximum depth, returning to the surface to telemeter the data. On the 7th and 8th cycles it encountered a relatively high bottom elevation (ca. 2500m), after which the depth increased again to more than 5000m. Note that this is not necessarily (and in this case is not) a cross-section of the ocean depth, because the buoy did not move along a straight line. →

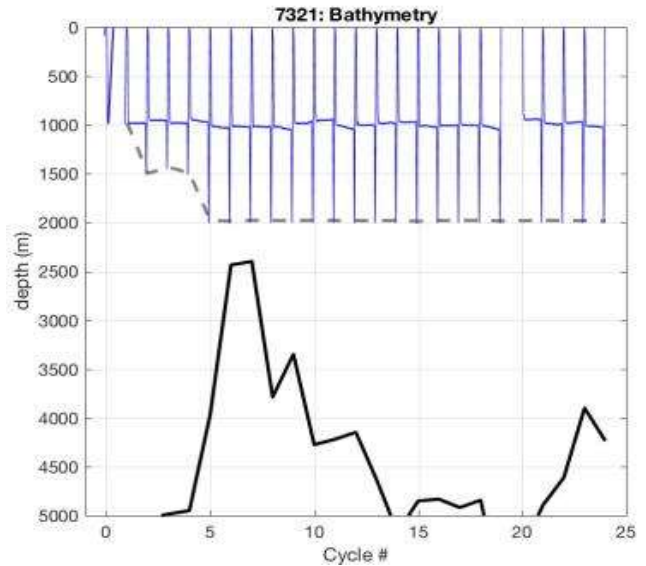


Figure 622 – Depth vs cycle #

The next three figures show functional data for all the cycles (up to October, 2016). The first shows the function P(T). It is perhaps easier to visualize this plot by rotating it 90° counterclockwise, *i.e.*, as the function T(P). Since pressure increases with depth, this shows that the temperature decreases with increasing depth to slightly over 2°C, where it is approximately constant. ↓

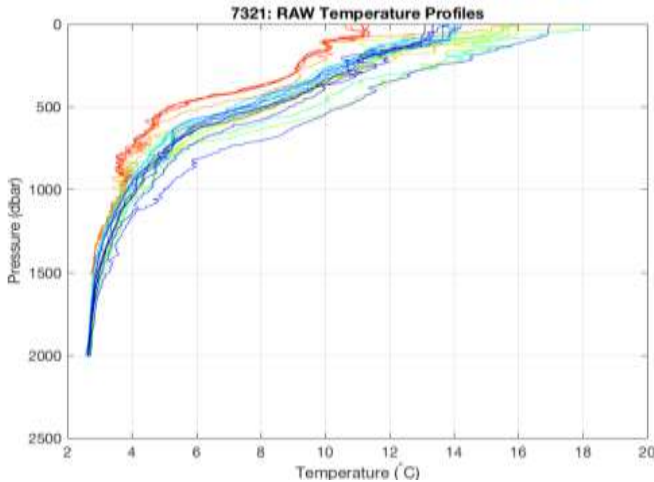


Figure 623 – Pressure [dbar] vs Temperature [deg C]

The two plots below show the pressure and temperature as functions of the salinity, *i.e.*, P(S) and T(S). These rather complex charts are derived from the multi-parameter data returned by the buoys. Thus, the function P(T) (figure at left) could be derived by eliminating S from P(S) and T(S). Of course, it is unnecessary to actually do this transform, because the parametric data is available; these plots are only representative of the opportunity to observe meaningful relationships between the parameters.

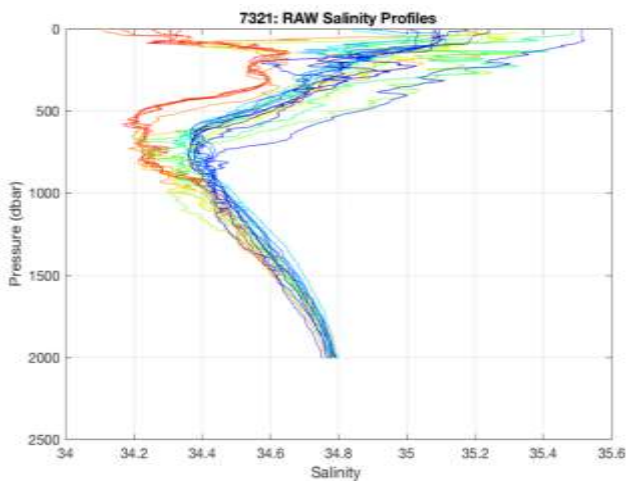


Figure 624 – Pressure [dbar] vs Salinity

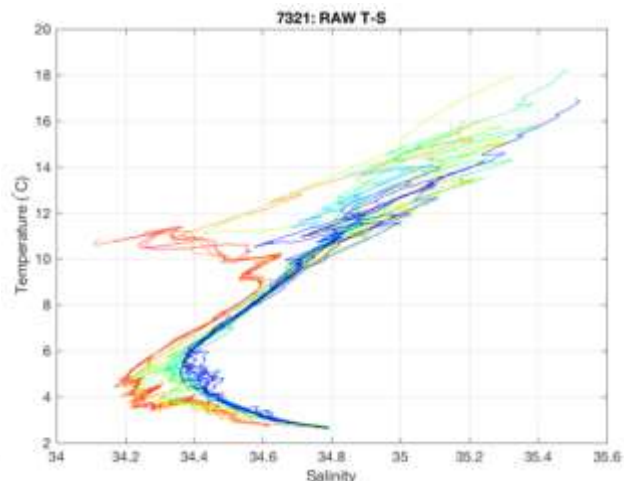


Figure 625 – Temperature [deg C] vs Salinity

Seabirds

[Prepared by: William S. Mitchell, III]

At six times during the Heard Island Expedition, 10-minute bird population counts were conducted. Four counts were taken at sea while approaching the Island from the west northwest, and two were taken from Wharf Point. A counting period of 10 minutes was chosen to keep consistency with the pelagic protocol used by Woehler. All six observations, plus those outside the Heard Island and McDonald Islands Exclusive Economic Zone have been entered into the eBird database of the Cornell Lab of Ornithology.

These counts identified thirteen species, although some birds were not identified to species level (some prions and all diving-petrels).

Surprisingly, of the prions identified in photographs to date, all have been identified as fulmar prions, despite Heard Island having an estimated breeding population of antarctic prions far larger than that of the fulmar prions. Additional photographs are being examined for non-fulmar prions, and a few have been found (1, 2, 3, 4) showing prions with smaller black tips on their tails (likely antarctic prions).

With limited experience with Southern Ocean seabirds and limited time for this project, no comprehensive survey of birds in Atlas Cove area was attempted.

Observations are available as eBird checklists online (<http://ebird.org/content/ebird/>):

[S29306717](#) (At sea)
[S29307121](#) (At sea)
[S29307404](#) (At sea)
[S29307648](#) (At sea)
[S29304030](#) (Wharf Point)
[S29304077](#) (Wharf Point)

Additional incidental observations included 20-30 Heard Island cormorants (*Phalacrocorax nivalis*) flying alongside the ship as it entered Atlas Roads on March 22. Macaroni and rockhopper penguins were seen from the landing boat, with perhaps 250 of each species in a mixed colony on the western shore of Atlas Cove.

Highest number observed during counts*	
Species or taxon	Number
King penguin	200
Gentoo penguin	9
Black-browed albatross	1
Wandering albatross	1
Southern giant-petrel	80
Cape petrel	3
Fulmar prion	18
Prion sp.	22
Diving-petrel sp.	1
Wilson's storm-petrel	7
Heard Island shag	7
Black-faced sheathbill	1
Brown Skua	4
Kelp gull	4
Antarctic tern	3

*Taxa and highest number counted during 10-minute observation periods.
 Incidental sightings are not included.

Checklist

S29306717

Location

-52.8640, 71.8220, Heard Island and McDonald Islands, HM

[Map](#)

Date and Effort

Tue Mar 22, 2016 10:02 AM

Protocol:

Traveling

Party Size:

1

Duration:

10 minute(s)

Distance:

1.6 mile(s)

Observers:

Bill Mitchell

Species

2 species (+1 other taxa) total

1 Black-browed Albatross

4 prion sp.

Likely Antarctic or fulmar prions, but I was unable to distinguish in the field.

6 Wilson's Storm-Petrel

Checklist

S29307404

Location

-52.9302, 72.6933, Heard Island and McDonald Islands, HM ([Map](#))

Date and Effort

Tue Mar 22, 2016 12:16 PM

Protocol:

Traveling

Party Size:

1

Duration:

10 minute(s)

Distance:

1.6 mile(s)

Observers:

Bill Mitchell

Species

5 species (+1 other taxa) total

1 Black-browed Albatross

2 Southern Giant-Petrel

2 Cape Petrel

18 Fulmar Prion

22 prion sp.

[Update]: Originally listed as 40 prion sp. However, all 4 photos have been identified as fulmar prions. Given a population of 40 and sampling 4 (with replacement), there is 95% confidence that 18 are fulmar prions. Counts have been adjusted to reflect both the fulmar prion ID, as well as the uncertainty in the overall count.

[Macaulay Library](#)

ML27897361, ML27897451, ML27897501, ML27897701

5 Wilson's Storm-Petrel

Checklist

S29307121

Location

-52.9150, 72.1912, Heard Island and McDonald Islands, HM (

[Map](#)

Date and Effort

Tue Mar 22, 2016 10:25 AM

Protocol:

Traveling

Party Size:

1

Duration:

10 minute(s)

Distance:

1.6 mile(s)

Observers:

Bill Mitchell

Species

3 species (+1 other taxa) total

1 Black-browed Albatross

1 Fulmar Prion

5 prion sp.

Likely Antarctic prions, though fulmar prion also possible; I was unable to distinguish in field. Pictures are representative, taken ~15 minutes after completion of count.

[Macaulay Library](#)

ML27896511, ML27896951

7 Wilson's Storm-Petrel

Checklist

S29307648

Location [North of Laurens Peninsula, Heard Island, Heard Island and McDonald Islands, HM \(Map \)](#)

Date and Effort Tue Mar 22, 2016 3:52 PM

Protocol: Traveling

Party Size: 1

Duration: 10 minute(s)

Distance: 1.6 mile(s)

Observers: Bill Mitchell

Species 7 species (+2 other taxa) total

1	Black-browed Albatross
1	Wandering Albatross
8	Southern Giant-Petrel
3	Cape Petrel
4	prion sp.
1	diving-petrel sp.
2	Wilson's Storm-Petrel
7	Heard Island Shag
3	Brown Skua

Likely Antarctic or fulmar prions. Unable to distinguish in field.

Unable to distinguish S. Georgian vs. common diving-petrel, both known to breed on Heard Island.

Checklist

S29304030

Location Wharf Point, Heard Island and McDonald Islands, HM
(Map) (Hotspot)

Date and Effort Sun Apr 03, 2016 12:55 PM

Protocol: Stationary

Party Size: 1

Duration: 10 minute(s)

Observers: Bill Mitchell

Species 8 species total

200	King Penguin
9	Gentoo Penguin
50	Southern Giant-Petrel
1	Wilson's Storm-Petrel
3	Heard Island Shag
4	Brown Skua
4	Kelp Gull
3	Antarctic Tern

Checklist

S29304077

Location Wharf Point, Heard Island and McDonald Islands, HM
(Map) (Hotspot)

Date and Effort Mon Apr 11, 2016 3:08 PM

Protocol: Stationary

Party Size: 1

Duration: 10 minute(s)

Observers: Bill Mitchell

Species 7 species total

150	King Penguin
3	Gentoo Penguin
80	Southern Giant-Petrel
1	Black-faced Sheathbill
4	Brown Skua
2	Kelp Gull
3	Antarctic Tern

Synoptic weather charts from Braveheart

Synoptic charts were provided by Braveheart. The following figures were those for 0600 and 1800 hrs on 27-29 March 2016.

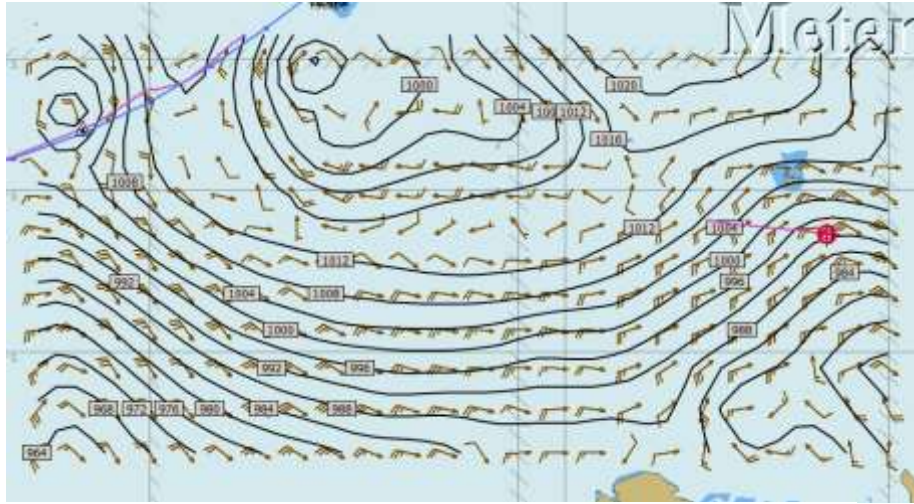


Figure 626 – 0600 27 March 2016

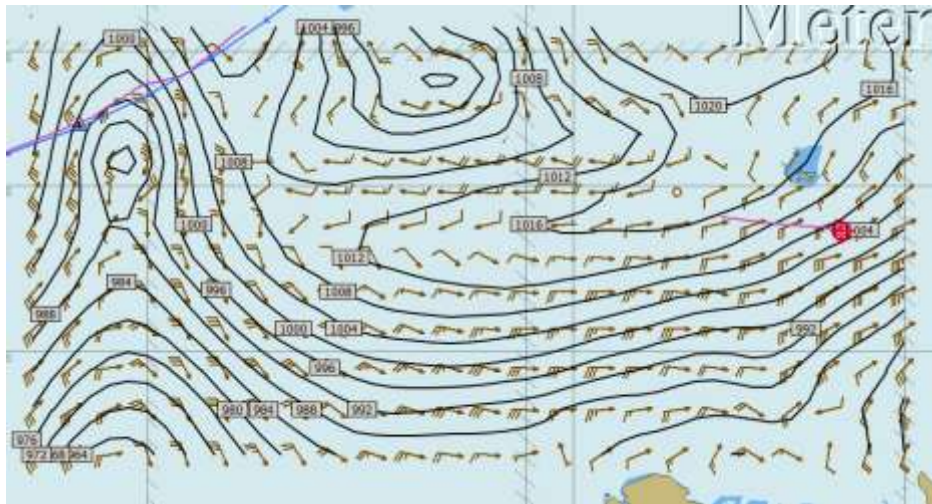


Figure 627 – 1800 27 March 2016

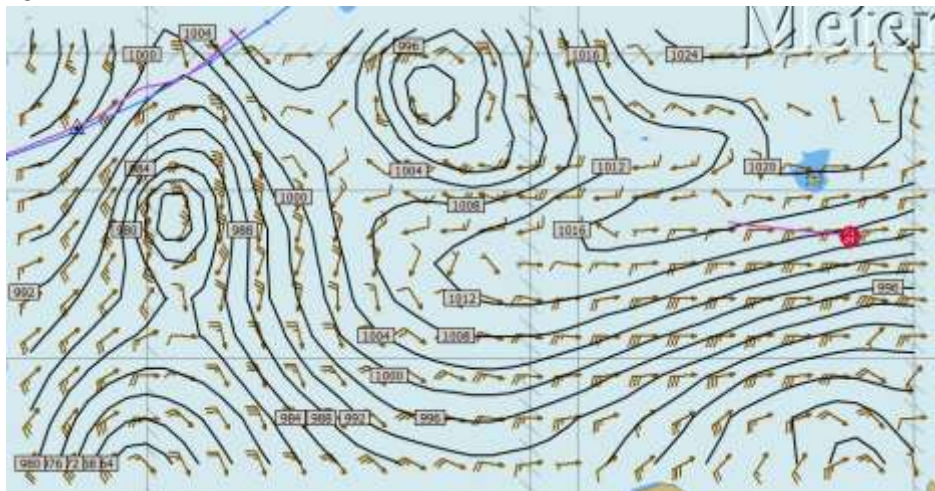


Figure 628 – 0600 28 March 2016

The movement of the highs and lows is easy to discern. With these charts, we were able to plan some of the operations, especially the timing of the excursion to Stephenson Lagoon.

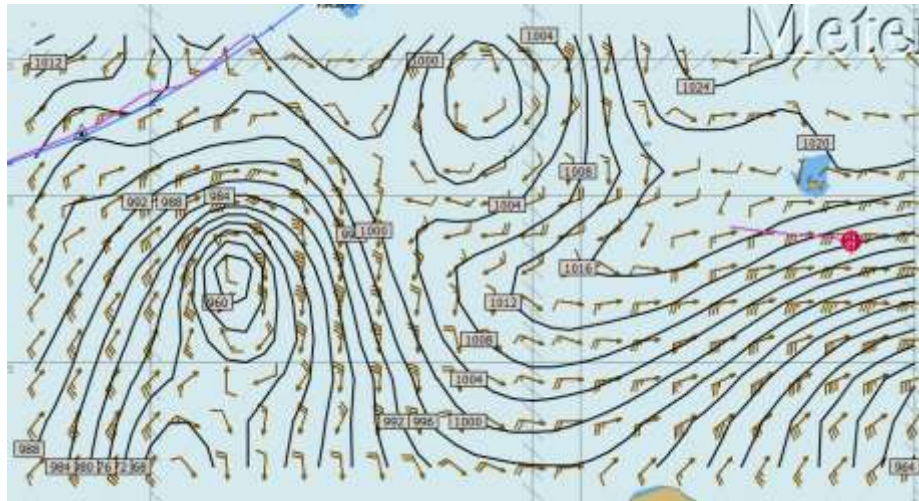


Figure 629 – 1800 28 March 2016



Figure 630 – 0600 29 March 2016

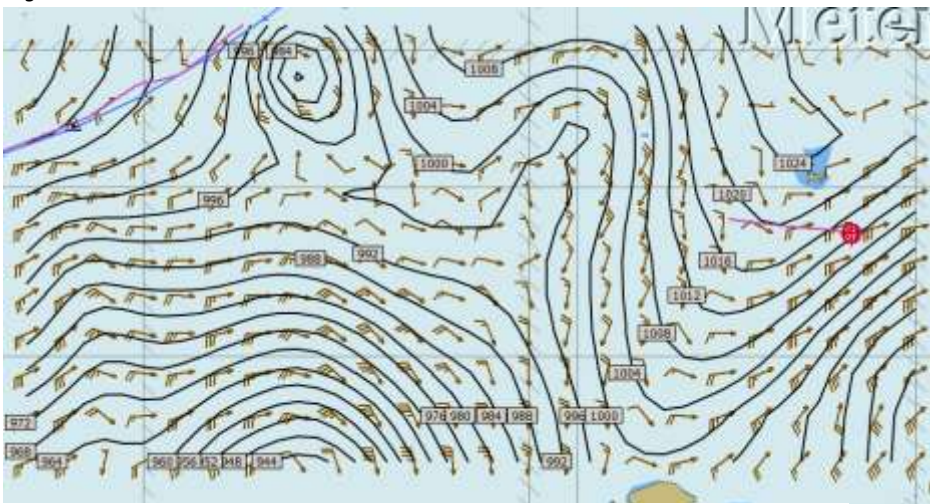


Figure 631 – 1800 29 March 2016

Weather at the campsite

The Kestrel 5500 Weather station (*cf.*, section on Operations) recorded the following data, among other minor measurements: temperature, barometric pressure, wind speed, wind direction, and wind chill. The following plots show the values of these parameters over the course of the stay at Heard Island (0000 31 March 2016 – 2350 4 April 2016).

We cannot account for the two high spikes in the temperature (to almost 65°F), and in fact we believe them to be instrumental, which is suggested by the drop-out of the wind-speed values about the same time. The steep rise at the end of the stay is due to packing the instrument onboard the vessel. Likewise, we cannot account for the two prominent drop-outs of the wind speed data.

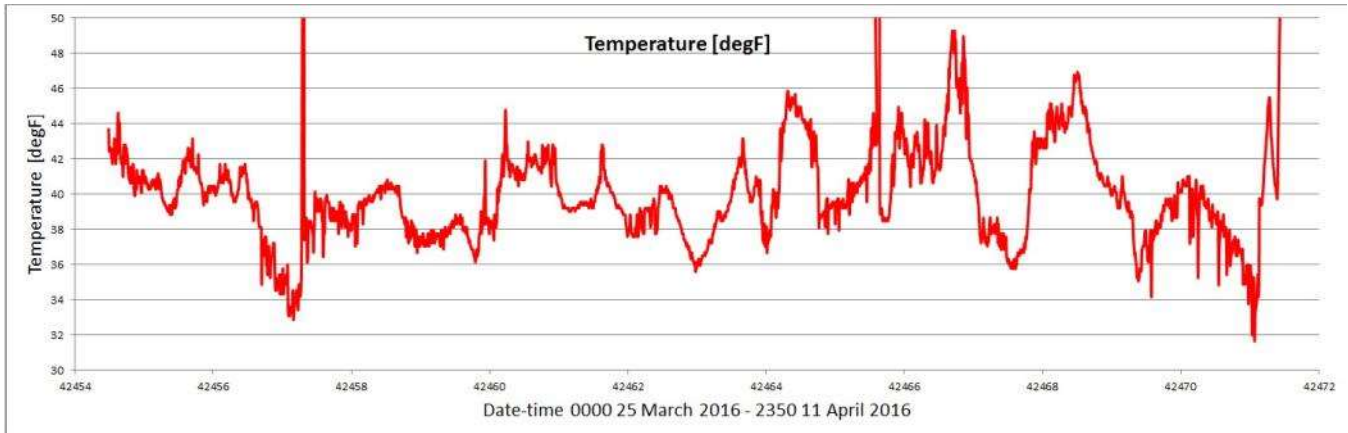


Figure 632 – Temperature: 0000 25 March 2016 – 2350 10 April 2016

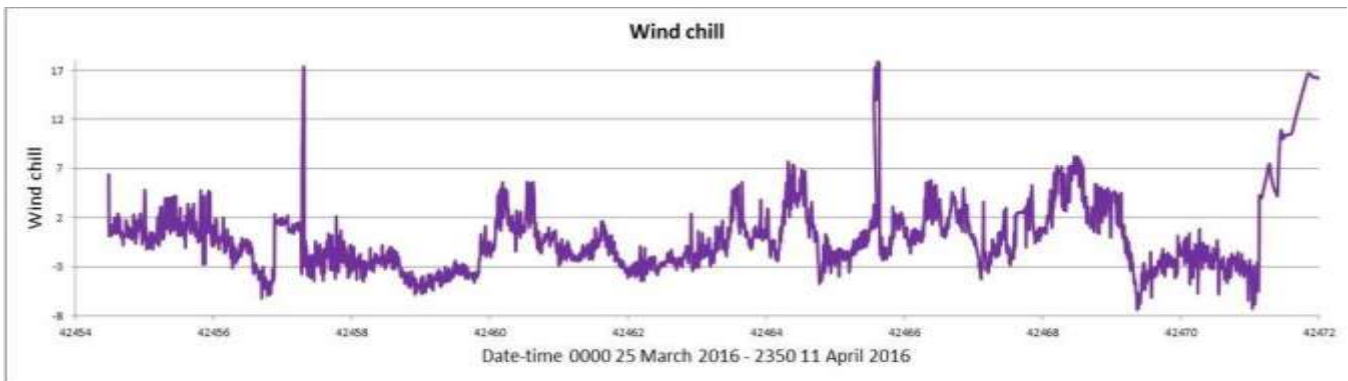


Figure 633 – Wind chill: 0000 25 March 2016 – 2350 10 April 2016

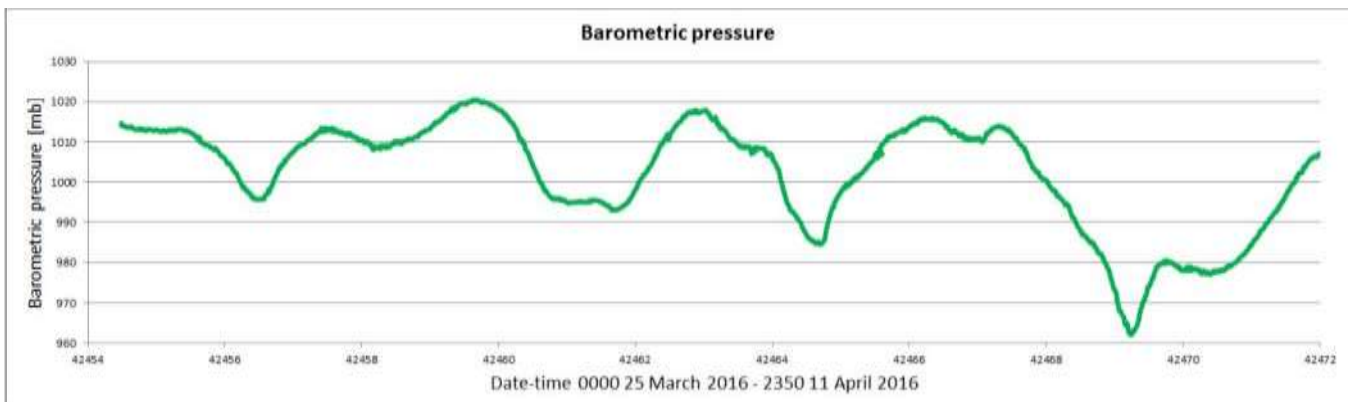


Figure 634 – Barometric pressure: 0000 25 March 2016 – 2350 10 April 2016

The next two figures show the wind speed and direction. The missing data (zeros on the plots) probably was due to jamming of the wind vane, since the other data shows no discontinuity.

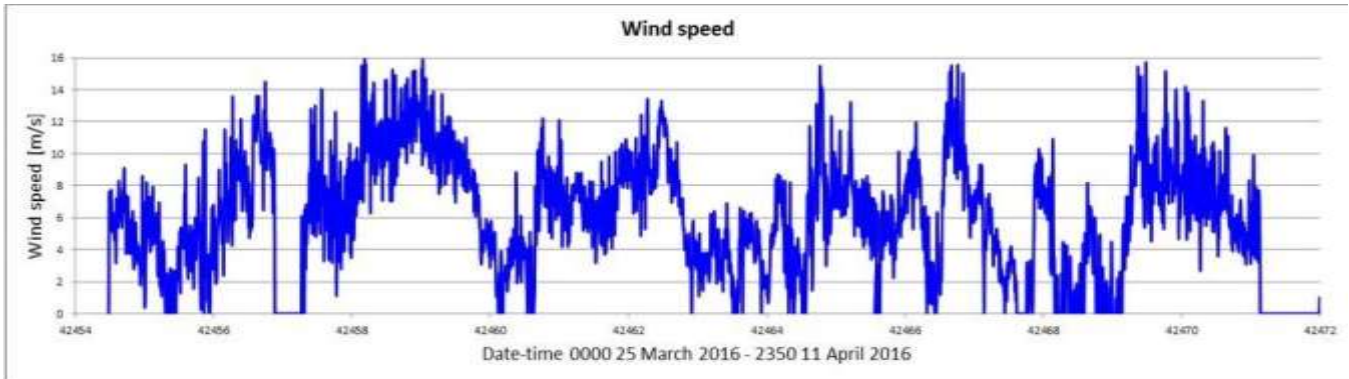


Figure 635 – Wind speed: 0000 25 March 2016 – 2350 10 April 2016

The following plot shows the wind directions. The plotted values have been shifted 180° from the number obtained from the instrument, in order to prevent introduction of artifacts due to the flopping over at 0°-360°.

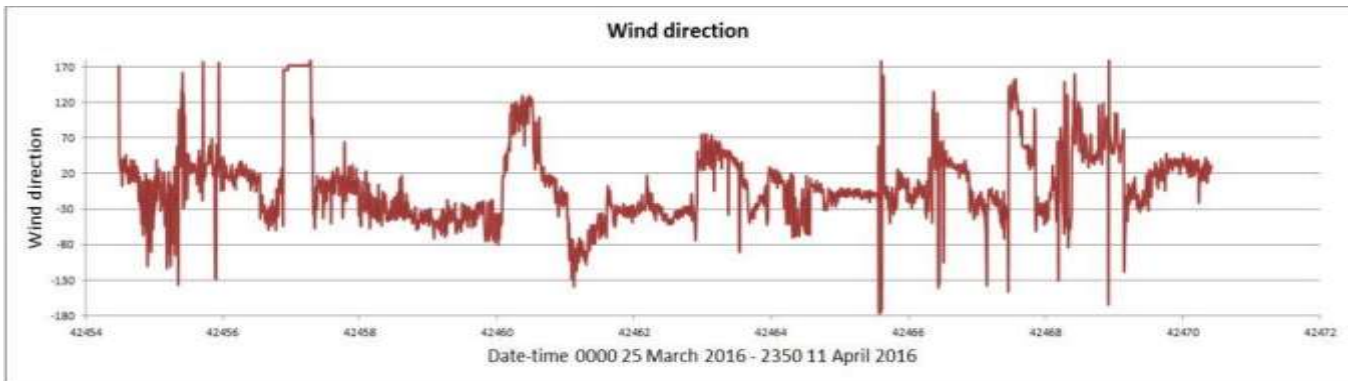


Figure 636 – Wind direction: 0000 25 March 2016 – 2350 10 April 2016

The following figure shows the wind speed as a function of wind direction, plotted with Cartesian coordinates. Clearly there is significant structure in this function, and we will seek a physical explanation for it.

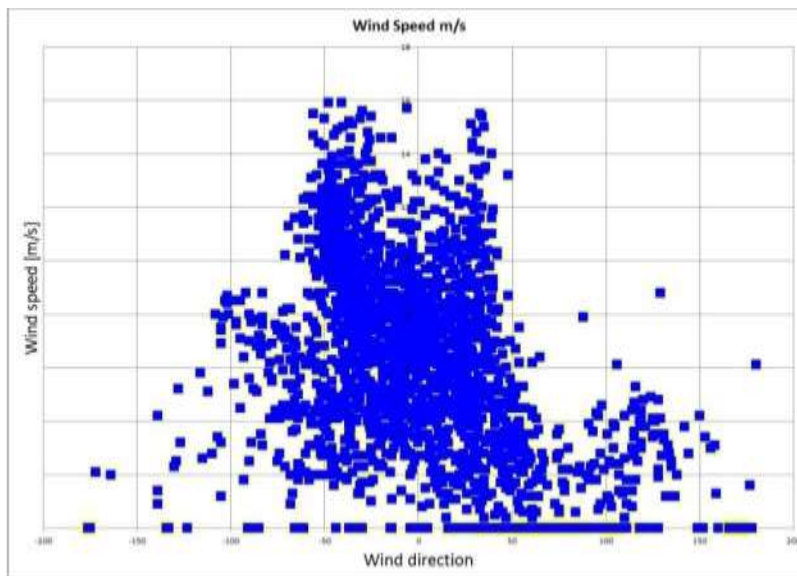


Figure 637 – Wind speed vs wind direction

The following figure shows the same data as vectors: the direction and magnitude of the wind. This plot can be visualized as “fanning out” the previous plot by opening the left and right quadrants down to the six-o’clock position, thereby distorting the distribution. Note that the resolution of the wind direction was 1 degree, expressed in the 1° angular spacing of these vectors, and the resolution of the speed was 0.1m/s, so many of the displayed vectors are actually multiple records.

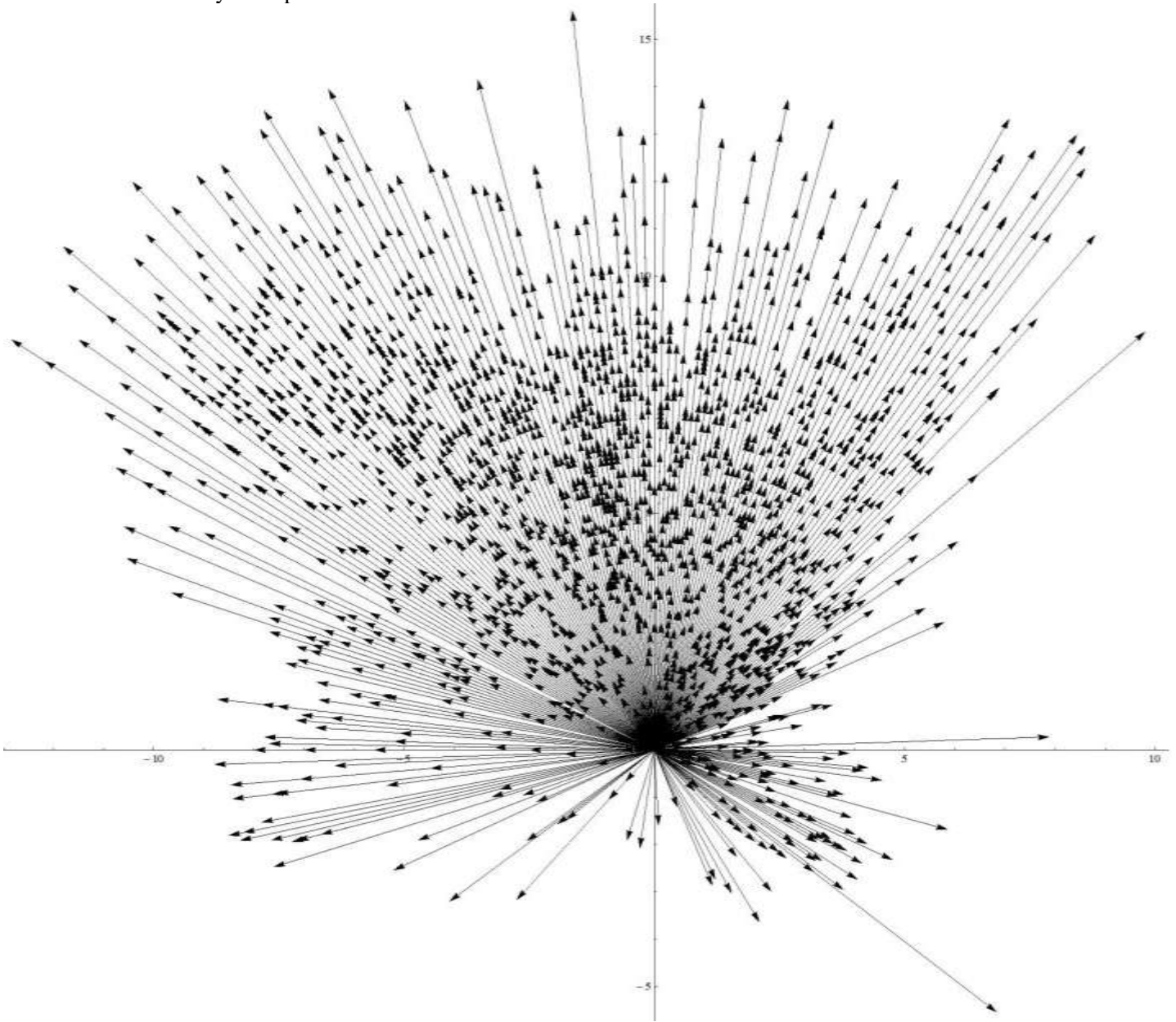


Figure 638 – The complete set of wind vectors recorded at Atlas Cove campsite. ●

The most striking aspect of this plot is that it is highly asymmetric: the predominant wind at the campsite was “up”, which corresponds roughly to east; north is to the left. Thus we see the fact that any visitor to Atlas Cove knows well: the wind is predominantly westerly.

Model of the wind at the campsite

We present here a possible very simple explanation for the structure in the wind vectors (preceding figure), based on the geometry of Laurens Peninsula. The core idea is that the peninsula modifies wind fronts by creating vertical-axis vortices which pass over the campsite, generating preferred directions for the wind during passage.

To motivate this model, we replot (below, left) the preceding data without the arrow shafts, as just points at the location of the arrowheads. Note the gray circle (midline slightly below center), which is the point of observation (the campsite). This plot helps us visualize the azimuthal structure in the wind pattern. If we take a bit of artistic license, we can draw a border around the distribution (below, right):

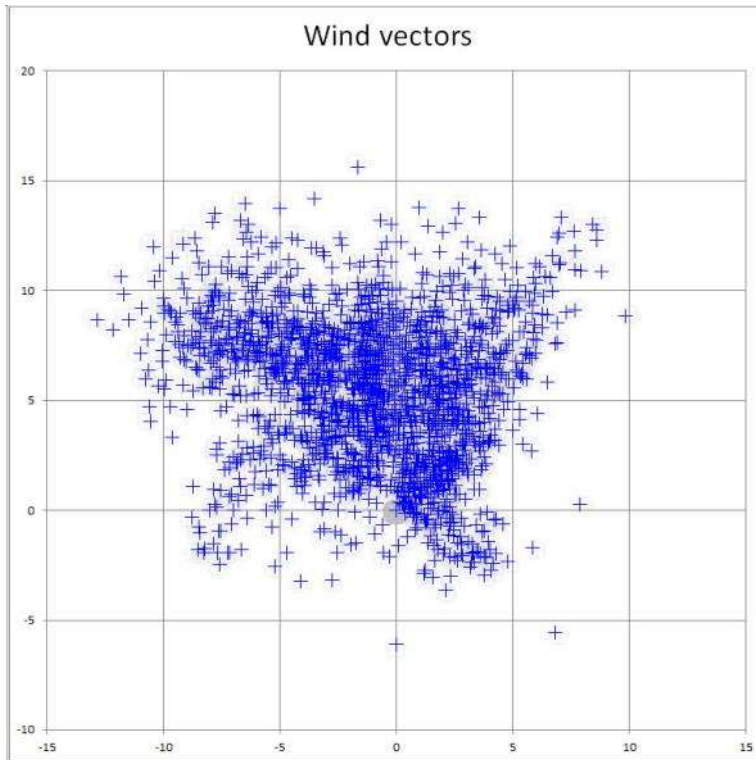


Figure 639 – Wind vectors. Plotted without the arrow shafts

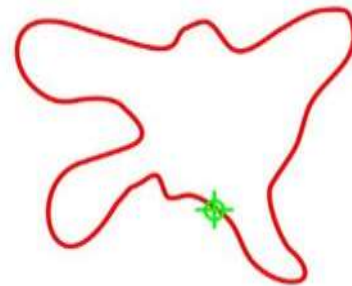


Figure 640 – Periphery of the wind. The mark is at the

Visually, there seems to be a suggestion of four major “arms”, and possibly some other minor arms. In other words, the wind seems to appear to come predominantly from four directions, which are very roughly orthogonal. The challenge, then, is to account for the roughly X-shaped wind vector distribution, *i.e.*, four arms approximately to the NE, SE, SW, and NW.

We begin by postulating that, when the wind encounters a huge steep barrier such as Laurens Peninsula, drag on one side creates vertical-axis vortices that move to the campsite, modifying the local wind vector. The vortices will be clockwise or counterclockwise, depending on the orientation of the barrier. Suppose a clockwise vortex is created and passes over the campsite. First the leading edge is felt, a wind directed to the right of the direction of travel. As the vortex centers on the campsite, the wind dies down (“the eye of the hurricane”), and as the trailing edge passes, the wind shifts to leftward. If the vortex is counterclockwise, the wind at the campsite is first left, then calm, then right.

The next two figures show graphically the local winds (black) for vortices moving to the right: vortices arriving at the campsite (blue), passing over the campsite (green), and departing the campsite (red). It is seen that clockwise vortices produce a local (campsite) wind that is first right, then left, whereas counterclockwise vortices produce a local (campsite) wind that is first left, then right.

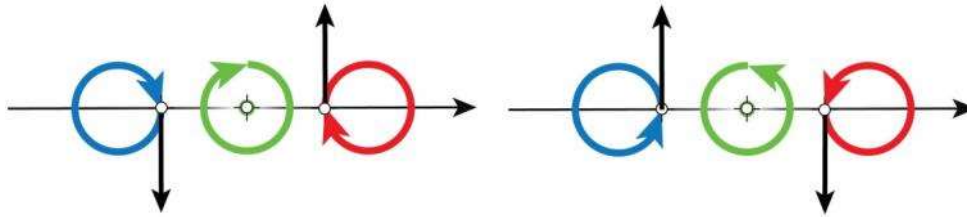


Figure 641 – Clockwise vortices

Figure 642 – Counterclockwise vortices

We now superimpose these vortex patterns on Atlas Cove/Laurens Peninsula region. The following figure shows the region, onto which we have drawn some vectors indicating presumed channels for wind fronts approaching from the NW and the SW, *i.e.*, the usual direction of the circumpolar wind. On this map we have also added two vortices (at three successive times, red, green, blue respectively), one coming into Atlas Cove from the NW, passing Laurens Peninsula on its right, the other approaching Atlas Cove from the SW, passing the peninsula on its left. These vortices are presumed to be formed by the drag of the peninsula on the otherwise flat wind front, which pulls the NW wind into clockwise circulation and the SW wind into counterclockwise circulation. Thus the NW vortex is “right-handed” and the SW vortex is “left-handed”.

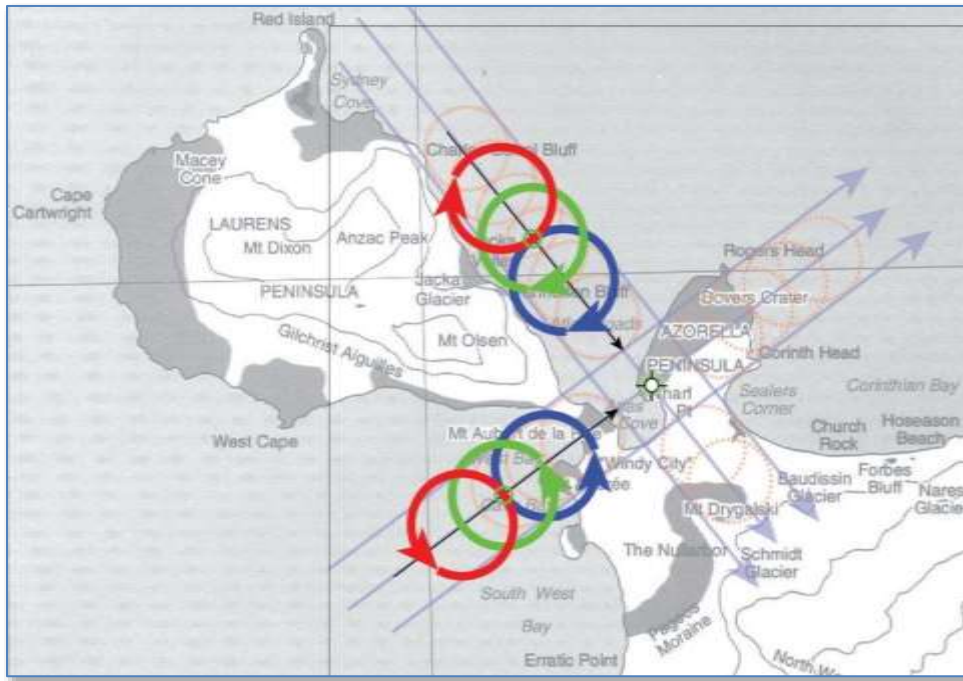


Figure 643 – Vortices produced by winds passing Laurens Peninsula

Laurens Peninsula is a steep-sided high monument; whereas the slope of Big Ben is relatively gentle and lows in the vicinity of Atlas Cove (the Nullarbor covers an area larger than the presumed vortex dimensions). Thus, it is not unreasonable that winds coming from the NW would “scrape” along on the peninsula and be deformed into clockwise circulation. Similarly, the SW winds would “scrape” their left side on the peninsula, deforming the flow into counterclockwise circulation. The relatively low-lying slopes of the Azorella Peninsula and the apron of Big Ben would not disrupt these vortices.

The next two figures show the vortices as they arrive at the campsite, pass over it, and then depart, continuing their forward movement. In both figures, the vortex encounters the campsite (red), is over the campsite (green) and departs the campsite (blue). The local winds sensed by the Kestrel instrument at the campsite are shown as straight arrows, red for the arrival and blue for the departure.

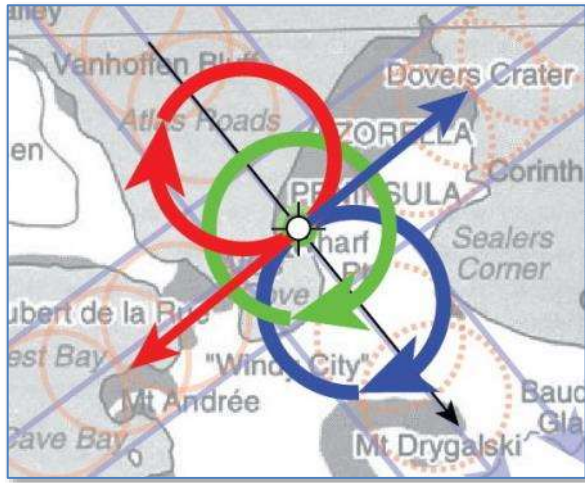


Figure 644 – Vortex winds at the campsite for NW winds

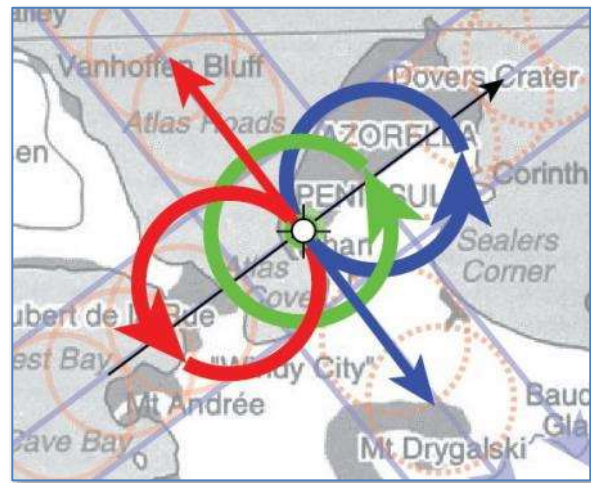


Figure 645 – Vortex winds at the campsite for SW winds

To the extent this picture is roughly correct, the predicted predominant directions of the winds at the campsite emerge (below, left). To emphasize that this model seems to predict the observed four-lobed azimuthal distribution, we show the arrows inside that distribution (below, right).

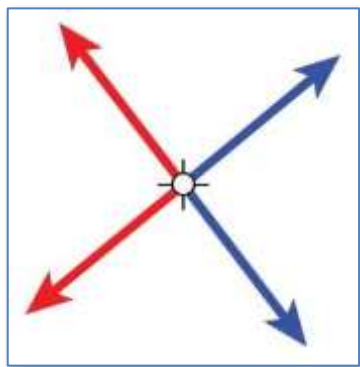


Figure 646 – The predicted dominant wind directions at Atlas Cove.

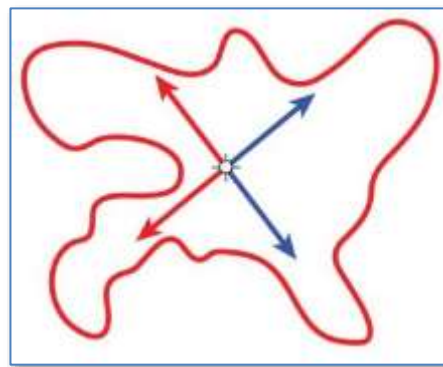


Figure 647 – Comparison with the model prediction and the 2016 observations

This model could be criticized on the basis of uniqueness: perhaps there are other scenarios that could predict the wind vector distributions. We also freely admit that we made a rather violent simplification of the data, although the multi-lobed structure of the distribution does seem real and needs an explanation. However, we claim that the model does actually afford a prediction that agrees with the observations.

Another weakness of this model is that the size distribution of the vortices is not known nor is easily predictable. We have assumed a diameter of the order of Atlas Roads (the entrance to Atlas Cove) for NW winds and of the West Bay for SW winds. The name “Windy City” that appears on the map is an indication that that area may define a characteristic dimension for the vortices.

Undoubtedly there is legacy data on the wind distribution of this location, but we have not had an opportunity to obtain it and make comparisons with the 2016 data shown here.

Temperature-illumination Atlas Cove

Five HOBO temperature-illuminance sensors were deployed on 27 March 2016, programmed to record each minute over the remaining stay on the island. All probes were recovered and the data read out.

The following image plots the temperatures in sequence, *i.e.*, by time, for four of the probes (the fifth was set to record at different interval). The dominant pattern is the obvious mid-day peaks, of which we can identify 16, the first being 27 March 2016. The initial peak at much higher temperature and the final 5-day stepped rise are due to removing the probes from storage and then replacing them in storage upon departure.

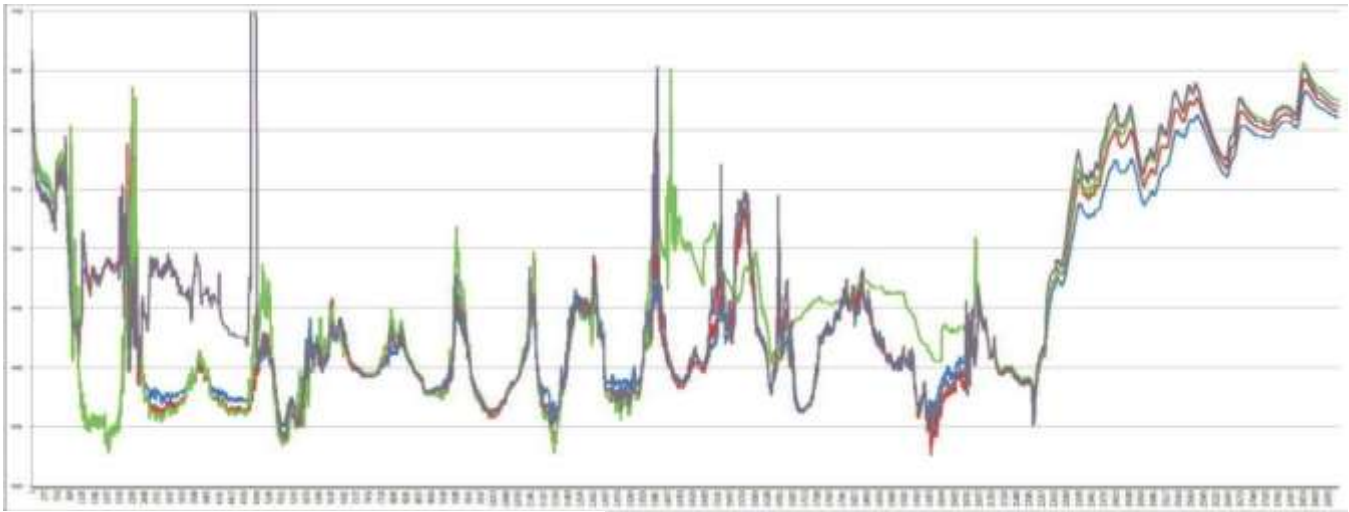
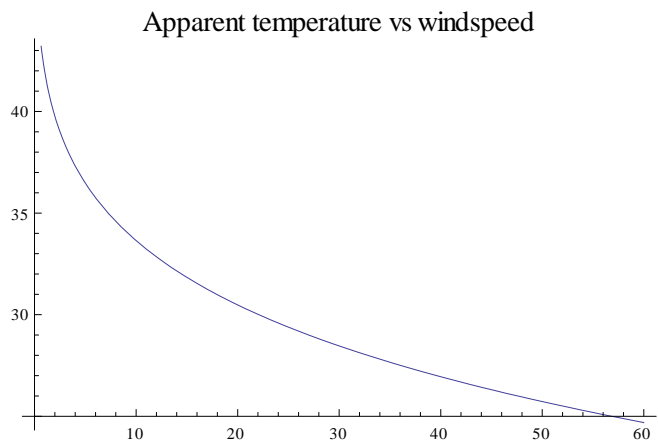


Figure 648 – Temperature vs time for 4 probes

It is interesting that overall three of the probes track rather accurately together, giving confidence of the data. However, there are two notable exceptions:

1. Probe XX (green track) made several very noticeable swings far from the other three probes, either much lower temperature or much higher.
2. Probe YY (purple track) made one swing to higher temperature than the other three probes early in the stay, including one spectacular spike offscale.

The close tracking of 3 or all 4 of the probes otherwise is good evidence that the probes were working, and were at least consistent. However, there is an apparent mystery in these data: the temperatures: they seem to be rather high. The scale in the plot above is 30°-70°F, so the temperature apparently never dropped below about 35°F. This was, of course, consistent with the fact that we never observed it to be colder than freezing. For the team, the wind chill made it seem like the temperature was below freezing, as the typical plot at right shows. This plot was calculated using the 2001 Standard Wind Chill Index [Source:



http://www.nws.noaa.gov/om/cold/wind_chill.shtml

$$T_{WC} = 35.74 + 0.6215 T - (35.75 - 0.4275 T) V^{0.16},$$

where T is in °F and V is the wind speed in miles-per-hour (mph).

The figure below shows the data for one of the probes. An interesting feature is the sharpness of the spikes.

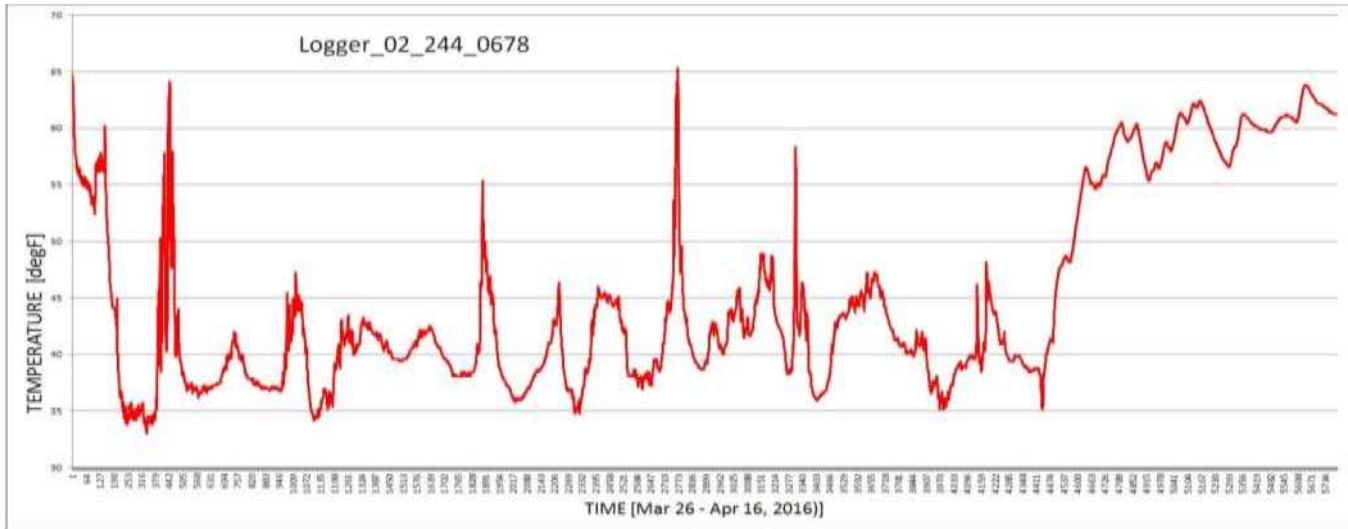


Figure 649 – Temperature vs time Probe 02

The next figure shows the close correlation between the temperature and the illuminance, as postulated above. While we have no detailed records of the cloudiness during these spikes, it seems reasonable that the spikes are due to direct illumination by the sunlight under clear skies. That is, cloudiness would tend to smooth and blunt these spikes. To the extent this is true, the temperature measures cloudiness.

The illuminance units on this plot are from 0 to 25,000 lumen/ft². Using the definition of the lumen, and the conversion $1 \text{ lumen/m}^2 = (1/683) \text{ W/m}^2$, we infer that the average peaks are of the order 150 W/m^2 . This can be compared with the solar illuminance (about 1360 W/m^2), corrected for latitude ($\cos(53^\circ) = 0.6$), or about 800 W/m^2 . This indicates that the typical peak illuminance on Heard Island is about 20% of the equatorial value.

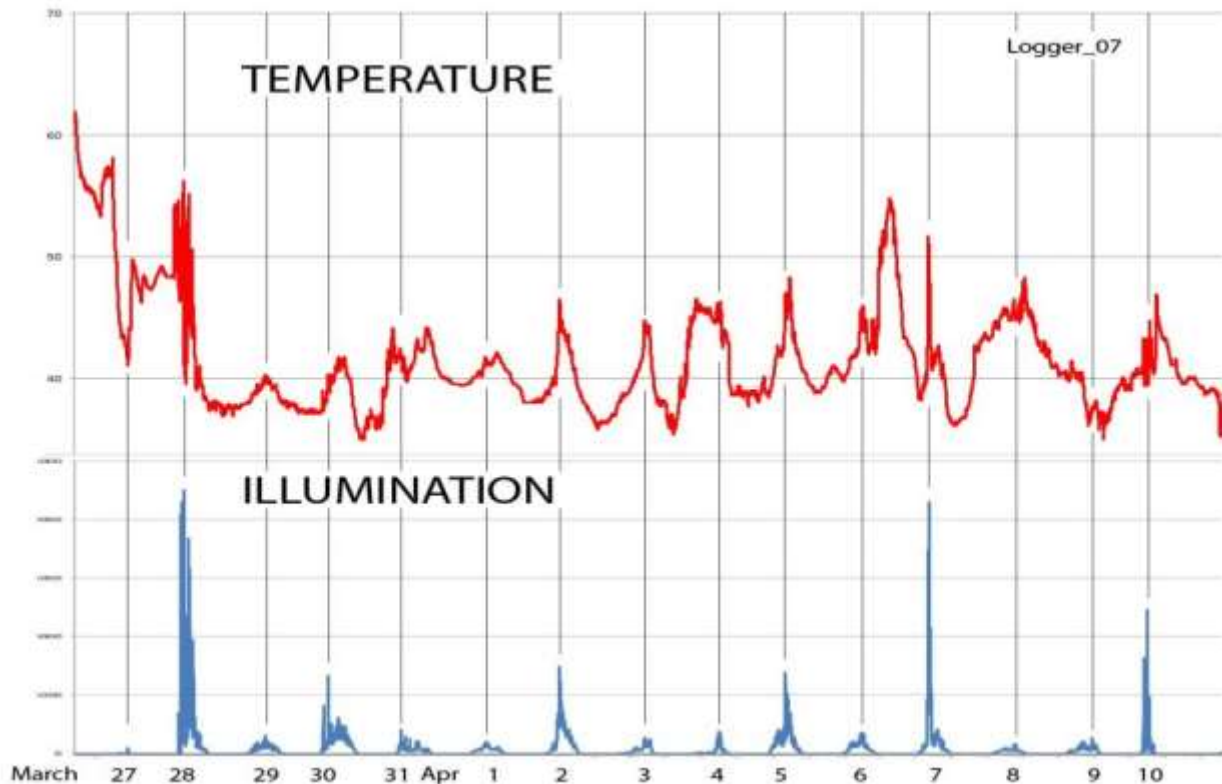


Figure 650 – Temperature, illuminance Probe 07

The figure below shows the temperature during the daily cycle (midnight to midnight) for four probes averaged together and the average illumination for the 24-hour cycle (midnight to midnight). Clearly, the temperature lags the illumination by about 4 hours (10AM vs 2 PM local). The relative roughness of the illumination curve compared with the temperature curve could be due to the local weather.

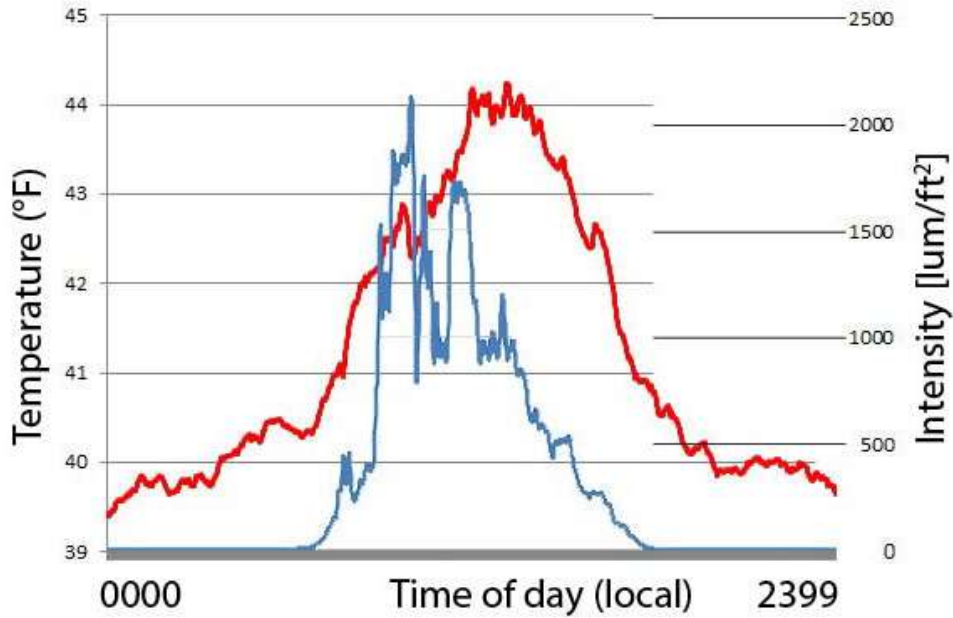


Figure 651 – Average temperature 24-hour day (4 probes)

The next figure shows the temperature plotted as a function of the illuminance for one daily cycle. This shows the temperature is roughly 40°F until the sun rises, after which it increases monotonically with illuminance to about 46°F. Thereafter the illuminance decreases and the temperature begins to fall to its nighttime value. An interesting function is the area within the closed cycle. Regardless of its irregularity, it will have a value of about 50 W°F/m². It is not known what significance this number has, but it will be a characteristic of the location.

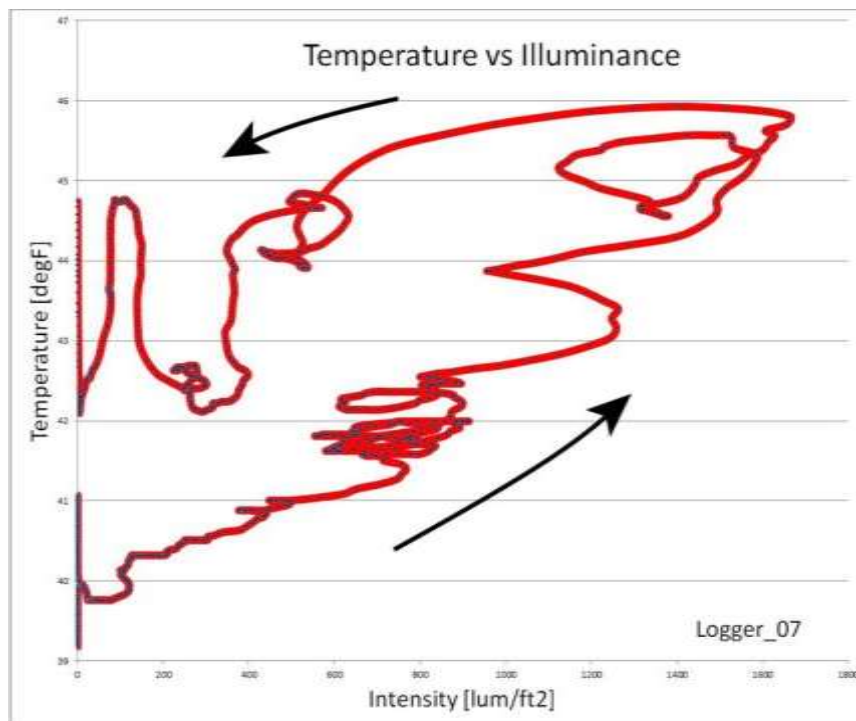


Figure 652 Temperature vs illuminance 1 day Probe 07

Article on debris

Team members Gavin Marshall and Fred Belton made the most extensive survey of the area around the Nullarbor and Mt. Drygalski. Marshall subsequently wrote an article for the Kathmandu 2016 Sustainability Report describing his observations of the debris he saw. We include a reprint of that article here, with permission.

CASE STUDY

ADVENTURE ON THE SIDE

Summit Club member Gavin Marshall calls himself a 'wannabe adventurer'. In fact, the Sydney-based New Zealander has climbed the highest peaks on four continents and volunteered as a paramedic for Search and Rescue. An accountant and project manager by day, Gavin took 10 months off in 2014 to chase his goal of scaling the seven summits.

In March 2016, Gavin embarked on his latest adventure, joining a 14-person expedition to sail to the remote Antarctic outpost of Heard Island to collect rock samples, photograph shrinking glaciers and conduct a beach debris survey.

Where is Heard Island?

Heard Island is one of the most remote places on earth. It's an Australian Territory located deep in the Southern Ocean, 3,500km to the south-west of Australia.

The island is one of the most biologically pristine areas in the world; home to a significant population of penguins, giant petrel, seals, and elephant seals. It's also home to Australia's only two active volcanoes and the slopes of Big Ben peak are covered in no less than 12 glaciers.

A journey into the unknown

When we set sail from Cape Town, I quickly realised that I wasn't mentally prepared for 12 days of travel by boat to Heard Island. It took me two days to get over the motion sickness, but then the boredom had set in. Breakfast, lunch, dinner. Those were the landmark times during the day and in between I was either asleep or lying in my bunk reading. It was a challenge to stay engaged mentally, and I found myself thinking about the people who regularly make this journey into this frozen wilderness. We arrived at our destination after a little over 12 days at sea.

I had entirely underestimated Heard Island. My first glimpse of the island was the cliff line silhouette of Lauren's Peninsula, poking through the mist and cloud. Below, the waves crashed onto rocks. We had a near complete view of Big Ben as we anchored in Atlas Cove on the first night and it was enormous. The crevasse slots of the glaciers cut up to the summit from the lower slopes between ribs of exposed rock. It was rugged beyond expectation. Sensory overload was an ongoing issue.

An unpleasant surprise

One of the most startling things we noticed was the amount of plastic debris on the western beaches, especially around Erratic Point.



We were dismayed at the level and type of waste that was washing up on the island. One of our commitments from the trip was to conduct a survey in conjunction with Australia's Tangaroa Blue Foundation, to determine the scope of marine debris and pollution on the shores of Heard Island. Tangaroa Blue estimate that there are 18 pieces of plastic per square metre of ocean. Being south of the major Southern Ocean currents, Heard Island should be free from plastic debris. Sadly, we found that this was not the case.

Moved to action

I was stunned by my first glimpses of the cliff lines of Lauren's Peninsula, but the most vivid picture I now have in my mind is of all the plastic drink bottles floating in the water at Erratic Point. I did not expect this simple data collection activity to have the emotional impact on me that it had. I felt sick. It reminded me of a rubbish dump. I now understand the Tangaroa Blue message: 'If all we do is clean-up, that is all we will ever do'. We have to do more.

To solve the problem of pollution caused by marine debris, we need to look at how we can stop the flow of litter at source, and help support local communities to tackle this problem. I feel fortunate to have had the opportunity to see this amazing place. But, I also feel moved to take action, otherwise future generations may not be so fortunate.

Are you inspired to make a difference in the world? If you have a plan to travel with purpose, then we're inviting you to apply for Summit Club Adventure Sponsorship.

'I did not expect this simple data collection activity to have the emotional impact on me that it had.'

Gavin Marshall

Sustainability Report 2016 47

Figure 653 – Article on debris on Heard Island, by Gavin Marshall

10. LOGS

Daily reports to the AAD

During the visit to Heard Island, the Expedition Leader made daily reports to the Australian Antarctic Division (AAD). Each report was in the following form:

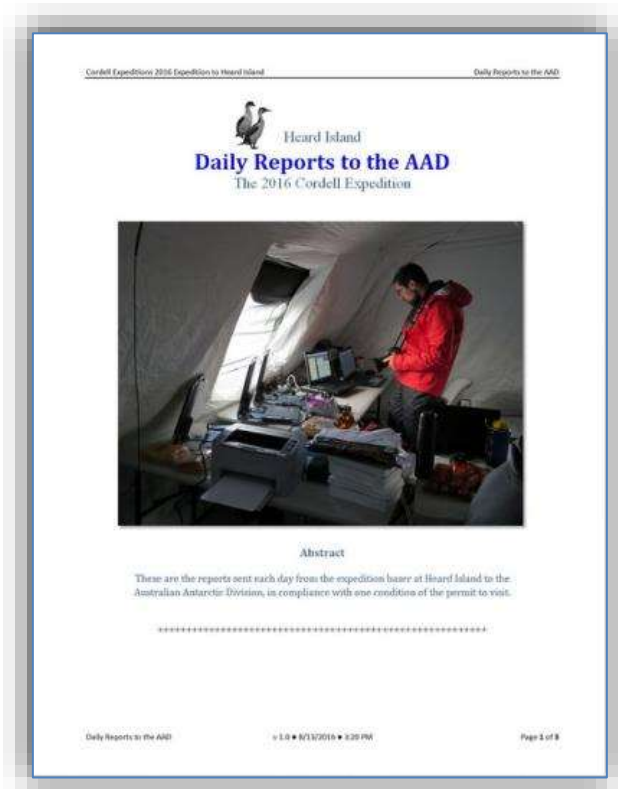


Figure 654 – The communications station used to make the daily reports to the AAD

These reports are reproduced in a separate document available from Cordell Expeditions. The daily reports are provided below, although we have omitted the environmental incidents (there were none) and the plan for the next day (these are mostly redundant).

At the end of this section we reproduce the Preliminary Review of the 2016 Cordell Expeditions Visit to Heard Island, provided to the AAD on 15 April 2016.

Report #

R. W. Schmieder, Expedition Leader

Date

By email to: himi@aad.gov.au

[Summary of the operations for this day]

[Health and wellbeing of the members of the party]

[Summary of any environmental incidents]

[Summary of the weather]

[Plan for the next day]

Report 032216 22 March 2016

Braveheart entered the waters at Atlas Cove mid-afternoon on 22 March 2016. The vessel crew made a preliminary reconnaissance of Atlas Cove beach and Wharf Point to determine the safety of landings. Following, four members of the Cordell Expedition team were put ashore for a preliminary inspection of candidate campsites. After determining that the proposed site was unacceptable, sites near the edge of the Nullarbor were investigated, but as the daylight was failing, it was decided to delay selection until the next day, and the group returned to Braveheart.

Report 032316 23 March 2016

With calm weather, the initial Cordell team was landed at Wharf Point at approximately 6:00 AM (local) and made a search for a campsite near the designated vehicle roadway at the northern edge of the Nullarbor. During this time the ANARE Zone was marked off using flags, and personnel were informed to stay out of the enclosed area and to not enter the AAD refuge shelters. After a short search, an appropriate campsite was located: a natural relatively flat terrace about 50 ft. from the Nullarbor roadway at the southern edge of the Main Use Zone and about ¼ mile from the ANARE Heritage Zone and from the beach. Braveheart crew then began landing the campsite equipment at the beach, starting with the main tents, using the ATV to move it along the designated roadway to the campsite. Landing operations took the entire Cordell and Braveheart crew all day; by evening the majority of accommodations were onsite, although not all were operational. After a break for dinner, it was decided to erect the first antenna and implement a basic HF station, and this was accomplished by 9:30 PM, whereupon the team retired for the night.

Report 032416 24 March 2016

As planned, the entire day was spent in working toward a fully operational campsite. This included numerous trips from Braveheart with equipment and supplies, further arrangement of the sleeping and living facilities and the galley, and organization of the generators and power network. The ATV has proven essential for transportation; it is used only in the vehicle path between the beach and the campsite. The generators were placed in the fully enclosing plastic cases that will contain any potential fuel spills. The main tent heater was found to be non-operational, and the backup was brought from Braveheart (the first night was spent without any heat in the tents, a rather brutal experience). The toilet was set up away from the camp in open air; waste is collected in a bucket and will be sent to Braveheart for disposal. Unknown problems were encountered with the radios. With only the rudimentary antennas up, troubleshooting the radios was extremely slow and limited. Additional trouble was experienced with the Inmarsat BGAN terminals, and considerable time was spent in troubleshooting these. The majority of the day's effort was expended in erecting antennas; no actual radio operations were conducted.

During the day the wind was less than 15 kt., mostly clear at low elevation but cloudy above 4000 ft.

Report 032516 25 March 2016

Today the team worked in the morning to establish reliable satellite connections. This was necessary because yesterday we received criticism from the radio community because they did not understand the difficulty of establishing the services. The difficulty was both establishing the satellite services and the radio antennas (the first day we only had about half of the required antennas operating). Once the satellite service was more operational (around midday), most of the team worked through the afternoon erecting and validating additional essential antennas. The results were positive and by 8:00 PM we have logged about 5000 contacts. Gavin Marshall and Fred Belton completed the walk on the beach lasting perhaps 4 hours, during which they documented some debris on the beach.

During the morning it rained moderately for about 3 hours. The wind blew in gusts during the night as usual, but during the day was less than 15 kt. Late in the afternoon there were gusts to 20 kt and the temperature dropped to 5 deg C. It was mostly cloudy above 2000 ft.

Report 032616 26 March 2016

Some members of the team continued to set up and adjust the antennas. As of this evening 8 antennas are erected, with an optional 2 or 3 more. The satellite connections were more reliable today, but with limited bandwidth, so some communications are very difficult to debug. Other members of the team continued to make radio contacts and by 8:00 PM the total exceeded 10,000. Gavin Marshall and Fred Belton completed the walk to the southwest of the Nullabor and documented large amounts of debris (plastic bottles, buoys, drums, medicine bottles, *etc.*). Compared to our observations in 1997, this represents a huge increase in flux of anthropogenic items. Some of the lightweight debris was found more than 500 m from the beach, apparently windblown. In addition they documented a large colony of king penguins, photographed from a distance.

During the night the wind was calm. In the morning it rained moderately for about 3 hours. In the afternoon the temperature dropped to 5 deg C. Again, it was mostly cloudy above 2000 ft.

Report 032716 27 March 2016

During the night we continued to log contacts, especially on the 160m band. Between two and five stations were kept operating all day; by evening we had logged more than 16,000 contacts. Gavin Marshall and Fred Belton shortened their plan for a day-long walk due to the higher winds and low temperature. In particular they abandoned the plan to ascend Mt. Drygalski (330m). They did reach Corinthian Bay, and documented the glacial steam and glacier terminus but did not proceed further. They also made an initial collection of water and soil samples. In addition, they deployed two of our 16 temperature/illumination sensors provided by OceanEarth. These will make recordings each minute for 20 days.

During the night the wind rose until the shelters were shaking rather noisily, although there is apparently no danger to them at this level. Again, it was mostly cloudy above 2000 ft.

Report 032816 28 March 2016

During the night we continued to log contacts, especially on the 160m band. Between two and five stations were kept operating all day; by evening we had logged more than 22,000 contacts. Some members of Braveheart brought lunch, after which they made a walk on the Nullabor in the direction of Corinthian Bay. Between 4:00 and 5:30 PM Bob Schmieder and Bill Mitchell made a photo-walk to Corinthian Bay.

During the morning the wind was up to 30 kt gusts. Again, it was mostly cloudy above 2000 ft. so the summit of Big Ben is not visible.

Report 032916 29 March 2016

During the night we continued to log contacts, especially on the 160m band. Between two and five stations were kept operating all day; Gavin Marshall and Jim Colletto made a walk toward Walrus Bay. The high winds and low temperatures limit our operations. The entire radio team stayed within the main camp and operated the radios; by evening we had logged more than 28,000 contacts.

During the last night and all day today the winds were gusty to 30 kt. As usual, it was mostly cloudy above 2000 ft. so the summit of Big Ben is not visible.

Report 033016 30 March 2016

By morning the storm that has buffeted our camp for 2+ days had abated but it remained very cold with light winds. The dominant activity remains logging radio contacts. In the early afternoon the decision was made jointly by the skipper of Braveheart and the Expedition Leader to land the field team of Gavin Marshall and Fred Belton at Sydney Cove on Laurens Peninsula. This was possible due to a break in the weather this afternoon during which it was relatively calm. The plan is to inspect the Apple shelter near Red Island to determine suitability for overnight use. If safe and useable, the team will plan a stay of up to 4 days, in order to obtain rock samples for Jodi Fox, as well as soil and other samples. As of this writing we do not yet have a report from them.

During the last night the winds were gusty to 60 kt., but in the morning it became calm. There was a spectacular sunrise in the morning, but unfortunately no one was available to photograph it. In the late afternoon, the clouds cleared and we had a spectacular view of Big Ben. Photographs clearly show that Mawson Peak continues to vent a gray smoke. Three photos (by Robert Schmieder) are attached below.

Report 033116 31 March 2016

The rain yesterday almost filled the entire Nullarbor. Fortunately it did not affect the operation of the antennas, and therefore the radio operation proceeded as normal. Tonight we will log 40,000 contacts. The message from Braveheart was that the field team (Gavin Marshall and Fred Belton) used the apple shelter last night, and presumably will again tonight. They reported no problems. It is expected that they are collecting specimens of rocks, soil, and water. One member reported encountering a collection of perhaps 6 dolphin skulls in a small area. While we do not know the cause, this could have been a killer-whale attack or an unexplained beaching. In the late afternoon we had another break in the clouds, and one member (Bill Mitchell) was able to obtain a very high resolution image of Big Ben using the GigaPan camera. The image shows the continuing smoking of the vent on Mawson Peak. The processed image below shows a substantial edifice topped by an apparent crater. This structure is in the position that we observed venting in 1997.

The wind has abated, and it is relatively calm tonight. Except for a few walks by two participants, the team has stayed inside the shelters.

Report 040116 1 April 2016

Today was devoted to radio operations and maintenance of the facilities. The routine involves operating the radios, filling generators, adjusting antennas, food services, and housekeeping. Now and then the power cables have to be re-routed; yesterday the hallway between the tents had to be reinforced. The vessel reports that the field team on Laurens Peninsula is healthy and functional. A decision on when to recover them has to yet been made. Today one elephant seal came through our campsite and moved on. We photographed it but otherwise stayed away.

It was cloudy all day; there was no view of Big Ben. The wind was relatively calm, with gust to perhaps 15 kt. The complete flooding of the Nullarbor that occurred yesterday was drained away almost completely by 10:00 PM. No one went on a field trip today due to the very challenging weather.

Report 040216 2 April 2016

Today was devoted to radio operations in the campsite. With the system stable, we are logging contacts at 5000-6000/day; by this evening we had logged more than 50,000. The vessel reports that the field team on Laurens Peninsula (Marshall and Belton) is healthy and functional. They will be recovered on Monday. During the day Braveheart made three trips to enable team members to take a shower and change clothes. The accompanying photograph shows Braveheart at anchor in Atlas Cove. In the late afternoon three members (Schmieder, Mitchell, Brown) took a walk along the beach to the west of the camp. An orange boat fender about 4 ft. in diameter was observed onshore, apparently broken loose from a vessel. It was left as found. A few other team members photographed a penguin colony in this vicinity.

The weather today was typical of Heard Island: cold, moderate wind with gusts, overcast.

Report 040316 3 April 2016

At the campsite today, radio operations continued, and a few team members took short photo-documentation hikes. In anticipation of poor weather in the next few days, the crew of Braveheart retrieved Laurens Peninsula field party (Marshall and Belton) today. They report the apple shelter at Red Island was serviceable, but all the provisions inside (*e.g.* food, fire extinguishers) are unusable. The door of the shelter was intact, but the pins in the hinges had corroded and sheared off and the gasket around the door is leaky. They left the door closed and held in place securely with rope.

The weather today was cool (high of 5-6 C), light to moderate winds from the west, and overcast clearing around sunset. At 1500z, the weather was clear, the temperature was 5 C, there were light winds from the west, and the pressure was 1008 mbar.

Report 040416 4 April 2016

[Prepared by W. S. Mitchell]

At the campsite today, radio operations were underway. With rain present and a storm expected, no team members went on hikes. Additionally, team members held a video chat with students at a school in Kiev, Ukraine, discussing life on Heard Island and the science being done on this expedition. Braveheart, with team members Schmieder, Marshall, and Belton, repositioned to stay in the lee of the island as a low pressure system came through.

The weather today was rainy. The high was 7 C, falling to 3.5 C in the evening. Sustained winds were generally light, but strong gusts capable of significantly impeding walking were observed. At 1400z, the temperature was 3.5 C, with strong westerly winds, and the pressure was 988 mbar.

Report 040516 5 April 2016

[Prepared by W. S. Mitchell]

At the campsite today, radio operations continued. There was very little rain and a few peeks of sunshine, so several team members went on hikes to Corinthian Bay. The three team members on Braveheart (Schmieder, Marshall, and Belton), landed at Stephenson Lagoon, navigating the landing boat in from the south side of the lagoon. The bottom grab was used to obtain a sediment sample from the bottom of the lagoon, and rock, soil, and water samples were taken as planned. From Spit Bay, smoke and steam were seen venting coming from Mawson Peak. After a few hours, the team returned to Braveheart.

The weather today was cool with gusty winds in the morning and a few periods of light drizzle. Most of the daylight hours were dry, with temperatures around 5 C and overcast. At 1700z, the temperature was 4 C, winds were light to moderate from the west, and the pressure was 1011 mbar under overcast skies.

Report 040616 6 April 2016

With the continued very poor radio propagation and moderate weather, some members of the team were able to go outside for walks to Corinthian Bay and along Atlas Cove beach. Again, the major activity was staying inside the tents and operating the radios. Today we passed 60,000 logged contacts.

Expedition Leader Robert Schmieder provided additional details of the visit to Stevenson Lagoon:

Braveheart left Atlas Cove around 11:00 PM on Sunday 3 April 2016. The run to Spit Bay area was done at 5 kt, so the vessel arrived in the early AM of 4 April. The sea was to 10 ft, winds 40 kt gusting to 60 kt. The entire day was spent lying at anchor about 1 mile south of the island. During the night the winds and sea reduced, and in the morning of 5 April the decision was made to attempt a landing within Stevenson Lagoon. The team (Schmieder, Marshall, Belton) plus two Braveheart crew members left the vessel at 10:00 AM. The southern breakwater of the lagoon was considerably degraded from the 2014 satellite images, and the entire breakwater was rolling with 4-6 ft. breakers. Passage was made with about 3 m of water. Once inside the lagoon it was immediately apparent that there were no icebergs—the entire lagoon was open calm water. Prominent on the left were elevations that showed the exposed layered blue ice described in our previous notes (“blue gash”). It was noticeably warmer and there was little wind inside the lagoon. Marshall and Belton were put on the beach to the west to examine the tarn that feeds the lagoon. The team documented the emergence of the subsurface stream seen in the satellite images. Following this, Schmieder made a photo survey of the western and northern boundaries of the lagoon, and made two collections of beach sediment and soil on the eastern boundary. The bottom grab was used to obtain one sample (ca. 100 cc) of bottom sediment, and two samples of lagoon water were collected. Lastly, the large penguin colonies on both the sides of the breakwater were photographed and roughly counted. Exit from the lagoon was made around 2:30 PM, through a dangerous surf with 6-8 ft. breakers. The sea had risen to 8-10 ft. by the time of return to Braveheart, which stayed at anchor overnight. This morning (April 6) she weighed anchor and returned to Atlas Cove to avoid an incoming weather system, arriving around 2:30 PM.

The weather today was typical of Heard Island: cold, moderate wind with gusts, overcast.

Report 040716 7 April 2016

Radio propagation increased moderately, and the operation continued normally. By the end of today we have logged 67,000 contacts. After an early-morning rain, the weather today was relatively mild, and several members of the team were able to go outside to accomplish additional goals. Gavin Marshall flew the drone, probably the first ever on Heard Island. He obtained video footage from above the Nullarbor, which was partially flooded by mid-morning. Fred Belton obtained additional rock samples for the Geology Department of the University of Tasmania. Bill Mitchell was able to obtain a 2 GB GigaPan image using the scanning camera provided by a sponsor. Two members of Braveheart crew obtained a chunk of glacial ice at the south end of Corinthian Bay and we preserved them as samples of the water and glacial inclusions.

Attached are several photographs from the visit to Stevenson Lagoon on 5 April. We are pre-processing the collected specimens, all of which can be classified as soil or rocks. A brief identification of the photos is provided in a separate email with the same title (Cordell Expeditions Report 040716).

The weather today was typical of Heard Island: cold, moderate wind with gusts, overcast.

Report 040816 8 April 2016

Again today, propagation increased moderately, and the radio operation continued normally, so as usual, most of the day was spent with radio operations. By the end of today we will reach 67,000 contacts. Fred Belton has spent most of the day organizing, labeling, and listing the various specimens. Several of the team members are taking walks in the Nullarbor area. The skipper of Braveheart and two crew members paid a visit in the afternoon and walked to Corinthian Bay.

It was exceptionally calm during the day, but there was a shower midday that completely flooded the Nullarbor. As of 7:00 PM it is still building, although we have observed that it drains almost completely in perhaps 12 hours.

Report 040916 9 April 2016

By the end of today we will reach 75,000 contacts (yesterday's report said 67,000 but that should have read 69,000). Propagation was slightly improved today. The Nullarbor is completely flooded: near our campsite the water is about 1 ft. deep. The skipper of Braveheart arrived midday and informed us of likely deterioration of the weather tomorrow, with high winds and rain, hence we likely will be unable to start moving our equipment until the next day. Gavin Marshall, Fred Belton, and Jim Colletto made a photo-documentation walk to the far side of the Nullarbor, returning early afternoon. During mid-afternoon the entire team began packing and staging equipment. In the evening we celebrated the 61st birthday of Alan Cheshire with a hearty meal, wine, balloons, and a Skype call to his wife in Perth.

It was rainy, foggy, and very cold during the afternoon.

Report 041016 10 April 2016

By this afternoon we reached 75,000 contacts. During this afternoon we took the official expedition picture, which will be posted on vk0ek.org. We have taken down most of the antennas and spent a large part of today packing radio stations and other gear in their shipping cases. The Nullarbor remains flooded, but the level of the water is decreasing. Braveheart was in 15-ft. swells all night, and with high seas in Atlas Cove the crew elected to not visit the camp. After some discussion we decided to repair the rusted door handles on the tank refuge shelters, and Alan Cheshire from Perth effected the repair. With the loss of the tent heaters, the tents are very cold (near freezing).

In the early morning the camp was hit by several intense gusts. During most of the mid-morning it rained moderately, but in the early afternoon it cleared, and there was considerable blue sky and little wind. The upper parts of Big Ben were, as usual, encased in clouds.

Report 041116 11 April 2016

Starting at 6:00 AM (local) the Cordell team and Braveheart crew began the process of dismantling the campsite. This involved loading one of the wagons with gear and towing it with the ATV to the beach, about ¼ mile distant, and returning for the next wagonload. The crew loaded about six wagonloads at a time onto the shuttle boat and transferred them to Braveheart, which was anchored in Atlas Road. By late morning the majority of the equipment at the campsite was moved, including the shipping cases with radio equipment, all of the antennas, the generators, remaining water and fuel, the tent heaters, furniture, beds, and most of the personal bags, and the tents were struck. This process was made more difficult by the flooding of the Nullarbor, although the ATV was able to negotiate water up to 1 ft deep. All the antenna support stakes from the entire site were removed. In the operating tent, the entire team signed the visitor log below a brief description of the project, and the Expedition Leader ensured that it was safely in the AAD galley (tank) shelter. Two sealed buckets of emergency rations (obtained from a commercial supplier) were left in the galley refuge shelter. The Expedition Leader retrieved all the flags that had marked the boundaries of the ANARE Heritage site. By 2:00 PM all items had been moved to Braveheart, and the team returned a few loose rocks to the site (that had been cleared for the tents). At this point, the Expedition Leader made a personal walking inspection of the entire site, ensuring that no remnants or other residuals of the occupation remained, and at 2:30 PM he left the site and walked to the beach to await evacuation. The entire operation of striking and evacuation took less than 9 hours. With everyone on board, Braveheart crew prepped the vessel, and around 9:00 PM weighed anchor and departed, destined for Fremantle, Western Australia.

This day we were blessed with very mild and calm weather, facilitating our rapid packing and closing of the facilities and their transport. However, around midday it turned very cold very suddenly, and hail (1/4") made a white layer on the ground. With predictions of high winds and colder temperatures the next and following days, it seemed clear that we were making our exit just in time before the turn into the winter weather period (late April).

Preliminary Review of the 2016 Cordell Expeditions Visit to Heard Island

R. W. Schmieder, Expedition Leader

15 April 2016

[This is a preliminary and informal description of the visit 23 March – 11 April 2016, provided as a courtesy to the AAD. It is not the anticipated Comprehensive Report, which will be far more detailed, including photographs, statistical results, descriptions of the specimens, *etc.* We reserve the option to revise, update, and extend this information in the Comprehensive Report.]

We made special efforts to carry out the 2016 visit to Heard Island within the conditions of the AAD permit, and we believe that was done without exception. Among other preliminaries, we developed a full Risk Management Plan, obtained Public Liability Insurance, and briefed the team on the detailed conditions of the permit.

The campsite was located at the extreme southeast corner of the Main Use Area, as far from the ANARE site and the AAD refuge shelters as possible. The ANARE Heritage Zone was marked off with flags and the team did not pass between them. Other than entering the AAD refuge tank shelter to sign the visitor book and repair the jammed door handles of both shelters, no use was made of the shelters. In exploring the surrounding area, the Cordell team stayed within the established Visitor Zone, and collections were made only within the areas defined in the permit by red polygons (Atlas Cove/Nullarbor, Laurens Peninsula, and Stevenson Lagoon).

The visit to Laurens Peninsula was done by landing two team members (Marshall and Belton) at Sydney Cove. They spent 3 days exploring the northern part of the Peninsula and collecting rock samples. They reported on the condition of the Apple shelter near Red Island. They remained below 400 m elevation during their stay.

The visit to Stevenson Lagoon was much briefer and more restricted than we had hoped: the weather break of only 3 hours prevented us from moving away from the lagoon itself. Consequently, we did not ascend to any elevation above the lagoon itself and the immediate shoreline, and we did not exit the Wilderness zone into with the Main Use or Visitor Access zones. Since we did not see the AAD tank shelters at Spit Bay, we cannot comment on their condition. Similarly, since we were unable to reach Brown Lagoon/Glacier, we could not make any collections or report on the retreat of the glacier and the recent exposed landscape.

The specimen collection is well within the limits defined in the permit. Although we do not have an accurate detailed inventory at this time, the collection comprises rock samples (to be shipped to the University of Tasmania), and soil and water samples (to be shipped to the U. S. Geological Survey, Menlo Park, California).

These and other aspects of the 2016 visit will be elaborated in the Comprehensive Report to be filed with the AAD on or before 22 June 2016 (60 days after the completion of the expedition).

Audio logs

Recording	Time	Summary
Listen	2016-03-08 23:43:39	Final Expedition Summary (3:55)
Listen	2016-03-24 00:05:11	BBQ party by NXDING: Leaving Fremont
Listen	2016-04-23 00:05:36	Teens in hotel, eating, cleaning
Listen	2016-04-23 04:28:31	Expedition cargo unloaded. Specimens cleared.
Listen	2016-04-21 02:54:13	At dock in Fremont. Beginning routine, including
Listen	2016-04-19 09:38:33	Calix sees early side. ETA Fremont Apr 22 AM.
Listen	2016-04-17 07:31:08	0300 am from Fremont. Live amateur call to Neil DX.
Listen	2016-04-18 03:48:11	Continuing underway. Rough seas last night.
Listen	2016-04-15 08:33:38	About halfway toward Fremont. Sea state reasonable.
Listen	2016-04-14 04:44:29	Crewing toward Fremont. Seas rising.
Listen	2016-04-12 07:24:20	All crew and cargo evacuated. Baseboat has left HE.
Listen	2016-04-11 09:29:56	Compuite completely clean and we are leaving.
Listen	2016-04-11 08:36:32	Compuite packing nearly completed. Fuel status.
Listen	2016-04-11 06:38:28	Packing camp: one tent down. Expect out this afternoon.
Listen	2016-04-10 16:34:21	Shutting down, packing. No tent losses. 71,000 QSOs.
Listen	2016-04-10 11:49:51	Dismantling, packing. Antisquat staking camp tentstove.
Listen	2016-04-10 10:04:31	Flooding. Baseboat in 15-18 words. Team photos with flags.
Listen	2016-04-09 09:41:20	WX report. Rain, wind, flooding. Begins packing.
Listen	2016-04-07 07:54:34	Details about visit to Stephansons Lagoon and Spat Bay.
Listen	2016-04-08 01:45:32	Return of field team to VKØEK compuite.
Listen	2016-04-06 00:41:00	Arrived back at Atlas Cove.
Listen	2016-04-08 03:49:14	At anchor off SE coast HE. Prep. to return to Atlas Cove.
Listen	2016-04-03 14:42:38	At anchor off SE coast, S of Spat Bay.
Listen	2016-04-03 09:57:38	Report from inspection of lagoons and Spat Bay coastline.
Listen	2016-04-03 04:41:38	Getting up to inspect Stephansons Lagoon and Spat Bay.
Listen	2016-04-03 03:22:58	At anchor vicinity Spat Bay. Plan to inspect lagoons, coast.
Listen	2016-04-04 04:38:50	Baseboat at anchor S and HE in high winds seas.
Listen	2016-04-04 00:13:42	Baseboat arrived to S and HE due to high winds seas.
Listen	2016-04-01 08:14:31	Review of previous message. No propagation.
Listen	2016-04-01 08:12:41	WX and DX report. Fine propagation. 81,000 QSOs.
Listen	2016-04-02 17:07:38	DX and WX reports. 60,000 QSOs.
Listen	2016-04-01 16:28:07	WX report. 41,000 QSOs.
Listen	2016-03-31 18:43:06	Antennae flooded at noon.
Listen	2016-03-31 09:42:15	Field team on Lawrence Peninsula.
Listen	2016-03-30 03:39:20	Winds have abated.
Listen	2016-03-29 11:26:21	Fill-in of summary from yesterday.
Listen	2016-03-29 12:22:11	High winds, low temperatures limiting operations.
Listen	2016-03-27 17:34:12	VKØEK daily operations, including internet. 14,000 QSOs.
Listen	2016-03-26 05:35:16	Catch-up AudioLog for past 3 days.
Listen	2016-03-23 15:13:29	Conditions and status. No status modification.
Listen	2016-03-23 11:39:06	Report of yesterday's recording. Conditions.
Listen	2016-03-21 15:52:21	VKØEK compuite complete.
Listen	2016-03-23 09:11:41	VKØEK compuite established.
Listen	2016-03-23 03:47:41	Locating compuite. [Audio dropped off.]
Listen	2016-03-21 03:45:44	[No audio]
Listen	2016-03-23 04:03:31	Re-recording of 1st landing on HE Atlas Cove.
Listen	2016-03-22 12:12:03	1st landing on HE Atlas Cove.
Listen	2016-03-21 14:57:32	Underway. Location: 12N 08E. 200 nm from HE.
Listen	2016-03-19 17:54:38	Underway. Location: 10S 06E. 700 nm from HE.
Listen	2016-03-18 09:58:35	Underway. Deployed 1st AR00 buoy.
Listen	2016-03-17 04:54:41	Underway. Halfway to Heard Island.
Listen	2016-03-13 18:55:50	Underway. Location: 47N 12E.
Listen	2016-03-14 11:25:09	Underway. Location: 44S 28E.
Listen	2016-03-10 15:08:45	Departure from Cape Town.
Listen	2016-03-10 06:36:00	Final preparations on Cape Town.
Listen	2016-03-09 14:59:56	Finalities on Cape Town.
Listen	2016-03-08 11:39:00	Update from Cape Town.
Listen	2016-03-03 08:58:43	Prepping gear on Cape Town.
Listen	2016-03-24 01:48:12	Heard Island expedition log. Date: 223.1719
Listen	2016-03-23 01:38:55	Heard Island expedition log. Date: 222.0111

Figure 655 – Web page with links to the daily AudioLogs

[This facility was set up by Mike Coffey KJ4Z.]

During the expedition recordings were made daily by the expedition leader, sometimes multiple times per day, by making a telephone call to a pre-arranged number. The answering software first asked for a title, which was given as “Expedition Log DATE.TIME. For instance, “Expedition Log 323.1252” was made on March 23 (2016), at 12:52 (local time). Then the software asked for the message, which could be any length.

These recordings were automatically posted on the web page <https://media.vk0ek.org/> and were immediately available to listening by anyone with a browser.



Figure 656 – The web page for listening to the AudioLog

Altogether 60 such log entries were made. These recordings were monitored by a large number of people, especially friends and relatives. Unfortunately the web page was shut down on April 5, although the recordings continued, and eventually the entire set of recordings was again made available after the end of the expedition.

Here we provide the transcription of the log entries, running chronologically.

The following table lists the recorded messages (normal chronological order). To listen to these messages, go to <https://media.vk0ek.org/> and click any link.

HEARD ISLAND EXPEDITION AUDIO LOG

Date Mo/Day/Yr	Time 24 hrs	Summary
2/22/2016	21:38	Heard Island expedition log. Date: 222.0135
2/24/2016	1:40	Heard Island expedition log. Date: 223.1735
3/5/2016	8:56	Prepping gear in Cape Town
3/6/2016	13:29	Update from Cape Town
3/8/2016	14:59	Formalities in Cape Town
3/10/2016	6:38	Final preparations in Cape Town
3/10/2016	15:08	Departure from Cape Town
3/14/2016	13:22	Underway Location: 44S 26E
3/15/2016	18:55	Underway Location: 47S 32E
3/17/2016	14:54	Underway. Halfway to Heard Island
3/18/2016	10:58	Underway. Deployed 3rd ARGO buoy
3/19/2016	17:14	Underway. Location 50S 56E. 700 nm from HI
3/21/2016	14:57	Underway. Location 52S 68E. 200 nm from HI
3/22/2016	13:12	1st landing on HI Atlas Cove
3/23/2016	1:01	Re-recording of 1st landing on HI Atlas Cove
3/23/2016	3:45	[No audio]
3/23/2016	3:47	Locating campsite. [Audio dropped off.]
3/23/2016	9:31	VK0EK campsite established
3/23/2016	12:52	VK0EK campsite complete
3/23/2016	13:10	Repeat of yesterday's recording. Conditions.
3/23/2016	15:15	Conditions and status. 30m station established.
3/26/2016	5:35	Catch-up AudioLog for past 3 days
3/27/2016	12:34	VK0EK fully operational, including internet. 16,000 QSOs.
3/29/2016	12:22	High winds, low temperature limiting operations.
3/29/2016	12:26	Fill-in of summary from yesterday
3/30/2016	3:10	Winds have abated.
3/31/2016	10:42	Field team on Laurens Peninsula
3/31/2016	18:42	Antennas flooded in rainstorm
4/1/2016	16:20	WX report. 45,000 QSOs.
4/2/2016	17:07	DX and WX reports. 60,000 QSOs.
4/3/2016	8:12	WX and DX report. Poor propagation. 61,000 QSOs.
4/3/2016	8:14	Review of previous message. No propagation.
4/4/2016	5:13	Braveheart moved to S end HI due to high winds/seas
4/4/2016	8:38	Braveheart at anchor S end HI in high winds/seas
4/5/2016	3:22	At anchor vicinity Spit Bay. Plan to inspect lagoon, coast.
4/5/2016	4:41	Gearing up to inspect Stephenson Lagoon and Spit Bay
4/5/2016	9:57	Report from inspection of lagoon and Spit Bay coastline
4/5/2016	14:41	At anchor off SE coast, S of Spit Bay
4/6/2016	2:49	At anchor off SE coast HI. Prep. to return to Atlas Cove.
4/6/2016	10:41	Arrival back at Atlas Cove.
4/6/2016	11:45	Return of field team to VK0EK campsite.
4/7/2016	5:54	Details about visit to Stephenson Lagoon and Spit Bay
4/9/2016	9:45	WX report. Rain, wind, flooding. Begin packing.
4/10/2016	6:04	Flooding. Braveheart in 15-ft. swells. Team photos with flags.
4/10/2016	11:49	Dismantling, packing. Anticipate striking camp tomorrow.
4/10/2016	16:24	Shutting down, packing. No tent heaters. 75,000 QSOs.
4/11/2016	6:59	Striking camp; one tent down. Expect exit this afternoon.

4/11/2016	8:36	Campsite packing nearly completed. Hail storm.
4/11/2016	9:29	Campsite completely clean and we are leaving.
4/12/2016	5:24	All crew and cargo evacuated. Braveheart has left HI.
4/14/2016	4:44	Cruising toward Fremantle. Team resting.
4/15/2016	8:13	About halfway toward Fremantle. Sea state reasonable.
4/16/2016	3:49	Continuing underway. Rough seas last night.
4/17/2016	5:31	1000 nm from Fremantle. Live satphone call to Intl DX conf.
4/19/2016	10:59	Calm seas, easy ride. ETA Fremantle Apr. 22 AM.
4/21/2016	22:54	At dock in Fremantle. Beginning customs, unloading.
4/22/2016	4:28	Expedition cargo unloaded. Specimens cleared.
4/22/2016	10:01	Team in hotel, resting, cleaning.
4/24/2016	0:05	BBQ party by NXDXG. Leaving Fremantle.
5/6/2016	23:45	Final Expedition Summary

The following plot shows the Dates vs Message Number. The last message was a summary

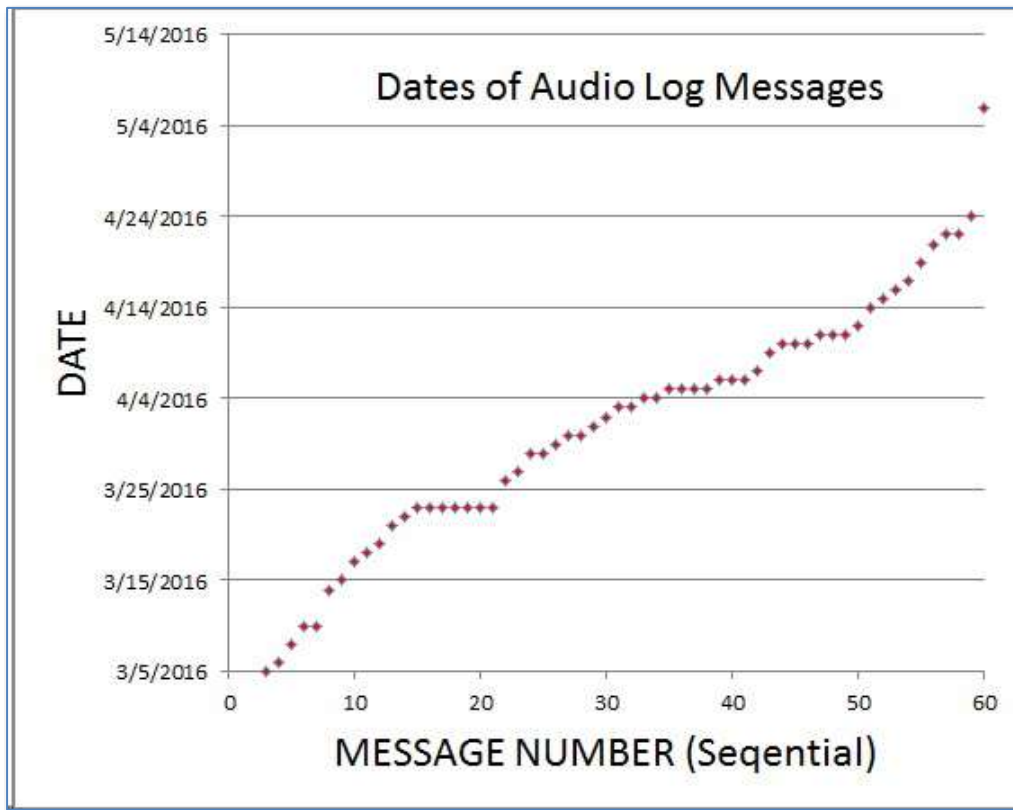


Figure 657 – The communications station used to make the daily reports to the AAD

Date	Time	Summary
------	------	---------

2/22/2016	21:38	OVERVIEW
-----------	-------	-----------------

2/22/2016	21:38	The Heard Island Expedition AudioLog
-----------	-------	---

This is Robert Schmieder, Organizer and Expedition Leader of the 2016 Cordell Expedition to Heard Island, in the Southern Ocean. I am recording this remotely on 22 February 2016, at 2:30 PM from Walnut Creek, California. This is the first entry in our online Audio Log (or podcast, if you like). The entries in this log will give brief summaries of the status and operations of the Expedition, as up-to-the-minute as you can get. We welcome you to check in now and then to get the latest updates.

The expedition has three main goals:

1. An amateur radio operation, using the callsign VKØEK;
2. Study of the major effects of climate change on this subAntarctic island;
3. Implementation of innovative communications, including real-time internet-based multi-media.

The expedition is scheduled to depart Cape Town, South Africa, on March 10, on the vessel Braveheart, carrying the team of 14 and crew of 5, and to arrive at Heard Island some 10 days later. We will remain on the island for 3 weeks, after which we will continue on to Fremantle, Western Australia.

Our equipment is already in Cape Town, and at this moment, the team members are making final preparations for departure. During the first week of March, we'll be in Cape Town making final arrangements and loading the vessel. A particular aspect of this expedition is that, because of the extreme sensitivity to importation of alien species to Heard Island, a condition of our permit is that all cargo be exhaustively cleaned and inspected, and this process will take the better part of a week.

So we invite you to follow the expedition on our three main websites, which are: www.heardisland.org and www.vk0ek.org, and www.dxa3.org. The last one carries our real-time online radio log DXA, which you can see right now in simulation. Again, it's at www.dxa3.org. And of course this site is <https://media.vk0ek.org/>.

Thanks for checking us out, and please come back often!

PREPARATIONS

2/24/2016	1:40	Travel preparations
-----------	------	----------------------------

Well, in exactly one week from now I will board a flight for Istanbul and from there to Cape Town, South Africa, to start the final preparations for the launch of the Heard Island expedition. As you might guess, there are many, many details to attend. All expeditions like this have a busy last few weeks before departure. Happily, I can report to you that it appears that for this project all the critical elements are in place, and we're mostly doing the details. My details include updating the expedition website, handling donations that continue to come in (thank you very much!), making final decisions on spending funds to obtain essential services, checking with various team members concerning the biosecurity plan, logistics, local communications on Heard Island, arrangements for the souvenir store, the QSL procedures and policy, final shipments of instruments and supplies, and so on. By the way, the souvenir store is open; you can go to heardisland.org and get a mug, shirt, and so on.

Just before I leave I will do two things:

I'll make some key changes on our website www.heardisland.org that will give you links to get information you may want during the expedition

I'll send out a final Newsletter that will give you lots of hints and links for making contact with us on Heard Island. If you haven't subscribed to the Newsletter, I can recommend it. Go to heardisland.org and click on the /NEWSLETTER/ link.

OK, until the next report, this in Bob Schmieder. Thanks for listening, and I hope you'll come back now and then.

3/5/2016	8:56	Prepping gear in Cape Town
----------	------	-----------------------------------

We are in Cape Town. All of our gear has been placed into a warehouse right here on the pier in the main harbor. Braveheart is tied up on the pier almost adjacent to us about 300 feet away.

We're going through a very stringent and somewhat complicated process of fumigating and

cleaning our cargo and the entire ship. This is a requirement for the permit to be given to us by the Australian Antarctic Division, the AAD. It's a fair amount of effort, taking several days, but it's going along just fine.

We're expecting more team members to arrive tomorrow and the next day, and there is every expectation we will be able to sail on Thursday, March 10 as scheduled on our way to Heard Island.

3/6/2016 13:29 **Update from Cape Town**

Yesterday we were able to get all our expedition cargo to the waterfront, a couple hundred feet from Braveheart which is tied up at the wharf.

We were able to deploy and erect our two main tents. This was a fairly straightforward operation and worked extremely well. Our tents went up in about 15 minutes with the air compressor. I will upload a photograph of those tents in place. We have services of Orkin to very thoroughly clean the tents as specified in the permit. They come with the pressure washers and chemicals to clean not only the tents but also the concrete pier underneath and all around.

This afternoon we are working on the electrical system for the tents, making a first layout of the cargo in the sequence that we hope to land on the shore tomorrow we will complete the setup of the other two tents before cleaning and go shopping.

We have a number of items to collect. There are useful shops we can visit whatever we want here. The weather is clear and hot, but very kind to us.

So everything is on schedule. One of our team members Alan Cheshire came to the airport picking up another team member Hans Peter from Switzerland's afternoon. Tomorrow five team members arrive in a virtually complete team plus one person. That's the update from today Sunday, March 6, 2016

3/7/2016 **No log**

3/8/2016 14:59 **Formalities in Cape Town**

We're toward the end of the day here in Cape Town. We have been all through our gear and the inspector has come and cleared us on all points. We are cleaned and ready to go.

Pretty much we have arranged the gear in the order of loading on the island, so Braveheart will pack it on the vessel in whatever order you see sensible. Tomorrow all the gear will go on Braveheart and the next day at 10 o'clock loading on the vessel and sail away.

There are no showstoppers and no problems, with one exception: Regrettably, Ken Karr has contracted a cold, and we have him in isolation. No other injuries, illnesses, or political problems. So it's all gone very much according to plan. We've had a lot of help your in Cape Town, especially Paul ZS1S, who has been everywhere picking up people, helping people go shopping, and so on. Without him it would have been much harder.

This afternoon after the inspector cleared us we started striking the main tents. At this point they're down, and packed in the bags.

We also acquired an ATV and we're going to take it with us since we have permission, so will be able to carry our stuff around the island dragged by an ATV, which will save our backs. That was really good news.

Just the completion of packing and personal shopping tomorrow, and the boats loaded, and we're off. The weather here is beautiful sunny warm, lots of beautiful shops—a very exotic place.

3/9/2016 **No log**

3/10/2016 6:38 **Final preparations in Cape Town**

Right now it's about 830 in the morning. The entire team is on Braveheart. We're waiting transport to the passport office in about an hour.

Once we get the passports stamped we will have a short interval to complete our shopping onshore, and sometime between 1400 and 1600 this afternoon, we'll sail out of Cape Town harbor and go directly south to encounter the winds and currents take us eastward toward Heard Island.

VOYAGE TO HEARD ISLAND

15:08 **Departure from Cape Town**

It's 8 minutes after 5 in the afternoon. We have left the dock in Cape Town Africa. At this moment going outside main gate into the port in Cape Town. The sun was getting low behind us. We have a tug as escort. We're passing the Agullas II to our left, for a while expected to be our expedition vessel. The crew is handling the dock lines. It's a beautiful afternoon, and we're on our way.

3/11/2016 **No log**

3/12/2016 **No log**

3/13/2016 **No log**

3/14/2016 13:22 **Underway Location: 44S 26E**
We're at 44° south latitude and 26° east longitude.

The sea state has been reasonably good. It kicked up a little this afternoon so we're having to hang on, but overall please that were not having seas that are slowing us down.

Earlier this morning we deployed one of the Argo diving buoys.

You can see our location by going to vk0ek.org. There is a track-us link there. With that you can watch the location of Braveheart as we proceed toward Heard Island.

We have a radio operating maritime mobile, using the callsign ZL/ZS9HI/MM. So far we have logged over 1500 QSOs. We also have the WSPR beacon working so we would be very appreciative of WSPR reports on 30 m.

All of the team is very grateful to the wonderful crew of Braveheart providing meals and safety and comfort for us, so we're having a great time.

3/15/2016 18:55 **Underway Location: 47S 32E**

We're at 47 degrees south, 32 degrees east. Local time is 8:55 PM. We have just deployed the second Argo buoy. We're about 40% of the way from Cape Town to Heard Island. ETA now very roughly estimated as midday March 22.

3/16/2016 **No log**

3/17/2016 14:54 **Underway. Halfway to Heard Island**

We are about halfway from Cape Town on the way to Heard Island.

Today we dropped one of the drifter buoys. We already have two Argo buoys in the water from before. This is a drifter from NOAA.

Today we saw for the first time some dolphins riding the bow of the boat.

The sea state is 1 to 2 m, quite an easy ride for us. The weather is very nice., surprisingly calm.

Most of the crew and the team have had a very restful day catching up on tasks and reading and resting and sleeping.

We had a little challenge with the Iridium. The antennas mounted permanently on the boat were not working because the satellites were at the horizon. So the skipper Matt pulled out a backup antenna and aimed it at the satellites near the horizon, so by virtue of that I'm able to make this report.

3/18/2016 10:58 **Underway. Deployed 3rd ARGO buoy**

Today we deployed a third ARGO buoy, this one dedicated to the Morrystown High School. It went into the water and drifted away. We got some very nice video of it.

We continue to work Maritime Mobile, now nearing the 5000 QSOs.

Today we crossed 50° S latitude.

We see that there is a low-pressure area approaching our direction, moving eastward as usual, so the next 24 hours will be kind of rock 'n roll for us. On the other side we will be a day or two from Heard Island, so possibly our next report will have an ETA for the island.

3/19/2016 17:14 **Underway. Location 50S 56E. 700 nm from HI**

We are at 50° south latitude ,56° east longitude, about 700 nautical miles from Heard Island. Right now it's 7:14 PM local.

We are running at 10 kt almost due east. We have a low-pressure zone following us and moving toward us probably overtaking us. We can feel that the sea has become rougher, and maybe

tonight will be the roughest night we had. We have really had very calm seas, so it has been an easy ride.

Our maritime mobile operation has gone over 6000 QSOs. We are very appreciative of the Xers who are working us.

3/20/2016

No log

3/21/2016 14:57

Underway. Location 52S 68E. 200 nm from HI

We're at 52° South, 68° east, about 200 miles from Heard island. We're expecting an ETA late tomorrow afternoon, and probably the first landing the following morning.

The sea state is quite acceptable. It's a relatively easy ride. We haven't run into any major storms.

We spent today taking inventory of the plans of the landing. First landing will be the ship's crew to recognize the conditions. Next landing will be the preliminary team to start setting up the shelters. Shelters will come (we hope) within about two hours or so after the landing. And about two hours after that the shelters will be up. After that will come the utilities, lights, furniture, and so on. After that will come food and equipment. Following that will be radio equipment. Following that will be the scientific gear. We may be able to get most or all of that onshore within one day, if we are able to start early in the morning and if the weather is cooperative.

Right now there's a light drizzle. We're running 10 kt but the wind is not very high so this is quite an easy ride.

On the maritime mobile operation we easily passed 6000 QSOs.

Everyone on the team is healthy. We take a lot of naps. There is not a lot to do.

We don't have access to our gear until tomorrow, when they will pull the cases out and we will go through some of the items we want to take onshore with us for the first few days. The general plan is to spend the first two few days say five days, at and around Atlas Cove. Obviously the principal operation will be the radio operations, but we will also have some people going out to field studies, to collect rocks and soil samples and water samples. After that perhaps after a week, if the weather permits, we will move a small team to the opposite end of the island, and carry out both the radio operation from there which should enable us to reach both the central and west coast of North America, and also the field studies.

We have several treks we want to take to reach specific areas that we've been able to see in the satellite images. In particular there is an erosive feature of a glacier, which we call the blue hash, that is most interesting, and also Brown Lagoon, which has experienced extreme glacial retreat. There is a large area at Brown Lagoon that is newly exposed, after having been glaciated for many millennia.

The area around spit Bay is called Stevenson Lagoon. Less than 50 years ago it was a glacier but now the glacier has melted and it's a lagoon. We want to explore that and see what organisms are moving into the newly formed lagoon.

While that's going on the radio operation will proceed. There are shelters there that were provided by the AAD in 2003. We will occupy those shelters, and it's a direct shot from radios there to Western and Central North America, and also many other areas of the world.

Today is the vernal equinox. We hope that you are watching our progress on the web from the tracker. If you are ham radio operator, we hope you are getting ready to contact us.

So we are about two days from starting the radio operation as VKØEK. When we do it will be our pleasure to log you. Please watch DXA which you will find on DXA3.org. It will give you a confirmation of your contact with us within 1 min. after you make contact. There are two things to remember: 1. If you get confirmation of your contact, do not make another contact; you are safely in the log. 2. If you do NOT get confirmation, please make another contact, and continue until you do get confirmation of a successful contact.

We will do our best to update the news outlets. The main outlet is the blog vk0ek.org maintained by Rich KY6R, as well as Facebook, Twitter, and other outlets.

We thank everyone who has helped spread the word about this project and about this the expedition. And of course we thank everyone who has contributed money or equipment to help make this a success. We are very mindful that you are our customers, and we are going to do

our very best to you back for your support.

OPERATIONS ON HEARD ISLAND

- 3/22/2016 13:12 **1st landing on HI Atlas Cove**
It is now 11 min. after 6 PM. We have landed on Heard Island. We are standing on the potential location of our campsite at Atlas Cove.
We had an incredibly beautiful and gentle weather situation when we arrived. At this minute we are looking at Mawson Peak, which is emitting smoke.
[Remainder of the log was lost due to satphone dropout]
- 3/23/2016 1:01 **Re-recording of 1st landing on HI Atlas Cove**
[This is a re-recording of the message of yesterday which apparently was not of good quality (yesterday afternoon about 5:14 PM local time)]
We are at Heard Island. We arrived on Braveheart around 4:30 PM. Came into Atlas Cove and came to anchor. Then the boat crew did a reconnaissance of the beach area at wharf beach and Atlas Cove area. Seeing that it was good they came back and took 4 members of the team, including myself. We scouted around the area including the ANARE site and our new potential campsite.
We were treated to a spectacular landing. There was visibility to the horizon at the North. All of Laurens Peninsula was visible. Now and then the slopes of Big Ben were partially covered with fog with sunlight behind. We saw perhaps three quarters of Big Ben up to the peak, an extraordinary display of visibility for Heard Island.
The temperature was quite chilly, but there was practically no wind. We spent about an hour onshore looking at the campsite and deciding where to put our shelter. It turned to be out more of a challenge than we had thought because of the nature of the ground. The site of our tents in 1997 proved to be unworkable for our current tents, because they do not have rigid floors. We will have to find another location for our campsite.
- 3:45 **[No audio]**
- 3:47 **Locating campsite. [Audio dropped off.]**
It's about 8:47 in the morning. The entire team is on Heard Island. We scouted the area and found the best campsite. It is very good. It is very near the Nullarbor.
[Rest of the message was not recorded due to satphone dropout.]
- 9:31 **VK0EK campsite established**
We have established site for VK0EK. We have both of our tents up and essentially completed. We have most of our gear shipped from the boat on site. We are using the ATV and the two wagons from Braveheart to carry the gear.
The weather has been just extraordinary: No winds, a reasonable temperature, visibility infinite everywhere, blue skies, beautiful view of Big Ben in front of our check.
We are currently putting up some of the antennas, and continuing to install some of the facilities here.
- 12:52 **VK0EK campsite complete**
Slightly dark. We've had an incredible day. Our main facility including both tents are up essentially complete with furnishings: the bunks, tables, chairs, furniture, most of the equipment.
The boat crew is bringing a hot meal as I speak.
We have 30 m and 40 m foursquare antennas almost up, so we have the possibility of coming on the air tonight.
It suddenly turned rather cold so I'll keep this short.
- 13:10 **Repeat of yesterday's recording. Conditions.**
[This is a repeat of the log from yesterday, which was not complete]
We started about six o'clock this morning, and we were treated to the most magnificent scenery you could possibly imagine. The sun ultimately came out and shone on the mountain. The fog cleared and we could see the peak of Big Ben in full bright sunlight. In the sunlight we could see

some smoke coming off Mawson Peak. There are large areas of green on the Lawrence Peninsula and on the slopes of big Ben. If that weren't enough, we had a rainbow right at the foot of big Ben on our right hand side. We could see the entire mountain and a rainbow at the same time.

We have huge numbers of King penguins which are very curious about us, coming to investigate us. In particular they were very interested in our white sandbags, which may have looked like penguins to other penguins. So they came and examined those. We are putting the last antennas and radios out and making them operational.

It's starting to get dark and cold. This is our first night on Heard Island. The Cordell expedition team is very close to being fully operational.

15:15 **Conditions and status. 30m station established.**

It's 8:13 PM Heard Island time. It's dark. Just a few minutes ago a very light sprinkle started but we're all inside for several hours.

Braveheart brought us a great hot dinner. We took a break from working to have that. We can report that 30 m is set up and ready to go, and we're working on 40 m now. We don't know yet whether we could pull it all together to get on the air tonight or not.

We're very tired. We started at six o'clock this morning, including the team of 14 plus 5 from Braveheart, working at an extraordinary rate all day, so everyone is extremely tired, but the adrenaline is pumping, so we are very eager to get fully operational.

The bunkroom is set up with bunks for everyone.

In the operations room we have several radio tables, an area for communications and science work. It's all driven by the 220 V from the generators provided by Braveheart.

Braveheart crew worked incredibly hard all day long. We had to transfer all of the gear from the beach approximately half a mile [actually about 500m] to the campsite. We use the ATV and the two wagons. Probably we could not have done it if we did not have this transportation.

3/24/2016

No log

3/25/2016

No log

3/26/2016

5:35 **Catch-up AudioLog for past 3 days**

Saturday morning on Heard Island. 10:33 in the morning.

A light rain and drizzle. I was unable to get satellite link to post this log in the last few days. The weather is cooperating.

We've been very busy erecting antennas, setting up the facilities with the Inmarsat BGAN terminals, the computer networks, life-support including a heater for the tent. The first heater failed to start so we brought in the backup. Now the tent is warm enough to operate.

As far as we know there are DX is out there who want to hear from us, and we want to hear from you as well. We have now logged approximately 8000 QSOs.

This has been an extraordinarily busy time for every member of the team. Everyone is healthy, working at, shall we say, peak capacity. Having a fine time.

Yesterday we made the first science field investigation. Gavin and Fred searched along beach areas for debris and found and documented some. They are off on a longer trip today which will also include getting some water samples. So the science component is proceeding.

3/27/2016

12:34

VKØEK fully operational, including internet. 16,000 QSOs.

We're practically fully operational here on Heard Island as VKØEK. We have pretty stable Inmarsat connections, so we've been able to implement regular e-mail, chat, utilities, and even opened up a Skype connection today that worked.

We have four or possibly five stations working almost continuously, just passing 16,000 QSOs, of which the preponderance are on CW: 13,000 CW and 2000 SSB.

It's been extremely cold. It rained and when it was rather violent this morning. It's clear near the ground but above us a couple thousand feet it's foggy, so we don't see the top of big Ben.

We had a milestone today: Kevin Fred went out on a field trip and were able to collect the first soil and water samples. So the science programs is underway.

Braveheart is supplying us with fuel and food on a regular basis which qualitatively changes how we can operate here. We make regular trips to the beach using the ATV and wagons to recover to obtain the food and supplies and return materials pots and pans food service items and Jerry cans for the fuel.

We're reasonably warm. The tent heater works intermittently so it keeps it relatively warm for us, although we are wearing heavy jackets.

We do monitor the DXA web page so we can see what's going on with the pileups. There was some trouble with server load, but KY6R, W6OP, and KJ4Z very competently adapted to the problem and solved it, because as far as I can tell it's displaying correctly. The "currently working" matrix shows five band-modes operating currently. Each time we track it, it agrees with the men at the stations.

So the report from here is very good. We're settling into not quite a routine. We're no longer in transient mode but rather we're getting into steady-state. We thank all the DXers working us and trust that you'll watch DXA. If you see confirmation no need for a dupe, but if you do not see confirmation try again until you do get a confirmed QSO .

3/28/2016

No log

3/29/2016 12:22

High winds, low temperature limiting operations.

In the past 24 hours we've experienced a very high winds and very low temperatures. Very limited time to go outside unfortunately.

[Rest of log lost due to satphone dropout.]

3/29/2016 12:26

Fill-in of summary from yesterday

I think that the sat phone clicked off in the middle of my report yesterday. Here's a summary of the past 24 hours. We've experienced high winds and very low temperatures, so outside is very difficult to work. We're staying inside and working radios.

We are discussing whether it would make sense to do any kind of operation and spit bay

3/30/2016 3:10

Winds have abated.

We're happy to report that the high winds that have been on us for the past two days have abated significantly, so it's quieter. The tent is pretty noisy when the wind is shaking it. In some sense you kind of feel like a big gust would take the whole system of way, fit. So relief from this wind is very much appreciated.

This morning I had an interview with W5KUB Tom and I think that that is available online.

We're continuing to log contacts right now. Were on 40 sideband, 30 CW, 20 sideband, and 17 CW. Total as of this moment, which is a little after 8:00 AM local time, that's UTC+5 hrs, is 30,308, of which 24,000 are CW and almost 6000 are single sideband.

3/31/2016 10:42

Field team on Laurens Peninsula

Yesterday our field team Kevin Marshall and Fred Belton was put onto Laurens Peninsula for a three- or perhaps four-day a research trip, especially to collect rocks for the University of Tasmania. They report that they are well and comfortable. There is a shelter that they can stay in overnight.

Overnight we had a long rain. The entire Nullarbor, the big flat plain in in front of our campsite, is completely flooded. All of our antennas are sitting in water, although I don't know exactly how deep.

Today it is overcast and rainy, but the wind has abated as the storm passed. The wind was calm last night, just a gentle breeze with minor gusts this afternoon. The team in the campsite is working as many of the DXers as possible. We're having reports that are signals are weak because propagation is not good.

18:42 **Antennas flooded in rainstorm**

It's about 11:40 evening. We had quite a rainstorm in the past day which completely flooded the Nullarbor, the large sandy area out in front of our campsite. Many of our antennas are sitting in water, but they continue to work because we continue to log contacts.

The wind was calm today, but this evening around nine o'clock the wind started, gently, nothing big.

The two men on Laurens Peninsula are safe, having stayed last night at the Apple shelter. Today

they are going out to obtain specimens. They will move toward a climb on Mount Dixon.

Pretty much the activity is staying inside and staying warm, refueling generators, which includes the heater for the shelter which uses diesel fuel. We have mostly 220 V in the tents supplying almost all of the electrical needs, although we do have one 110 V generator in the operating tent.

4/1/2016 16:20 **WX report. 45,000 QSOs.**

It's about 9:18 in the evening. It's been cold, mildly windy, cloudy, rather unpleasant outside so most of the team stayed inside most of the time. We have to go outside to fill the generators, but the generators needed no service.

We're just working radios. As of this moment we have 44,621 QSOs logged.

We were pleased that today Braveheart brought some clean laundry that we had sent to it. Alan VK6CQ maintains our galley, and prepares and services the dinner for us.

News from the team on Laurens Peninsula: apparently they are succeeding. They are safe and on the peninsula and staying in the apple shelter. Tomorrow probably more of the same; it's become a bit of routine.

We process a lot of e-mails. Of course I file a report with the AAD every day which I have just now finished for today. We can see the weather reports because we have an open Internet connection so we can download and upload documents. This keeps us rather busy.

4/2/2016 17:07 **DX and WX reports. 50,000 QSOs.**

The QSO count passed 50,000 today. In terms of rates of grace we are up with any other DX tradition, so this is an amazing performance here.

It was cold and windy and overcast most of the day, but there was a short clearing, so a few people were able to get out and get pictures of the mountain, including Mawson Peak which continues to vent. We can see some sort of combination steam and smoke. It's not lava, but it's clearly hot up there, 9000 feet high.

Today Braveheart took all of the team members in three trips to Braveheart for showers clean clothes which felt really good.

A couple of people went for walks today photographing penguins and elephant seals Azarella moss and Kerguelen cabbage and the things that are very common around here. Bill and I saw a fender, a 4-foot-diameter red plastic inflated fender, the kind is used to keep boats from damaging each other. It looked new. We didn't disturb it-just photographed at. It was a productive day.

4/3/2016 8:12 **WX and DX report. Poor propagation. 61,000 QSOs.**

It's about 1:12 in the afternoon. Boy have we had a rainstorm! It rained continuously for hours this morning. The entire Nullarbor flooded as it was previously. It's very uncomfortable outside, so we're staying inside.

Right now we are sitting at 51,189 QSOs. Unfortunately we are experiencing a major solar storm, perhaps a flare, so there is almost no propagation. We cannot hear any stations and apparently no stations can hear us.

4/4/2016 5:13 **Braveheart moved to S end HI due to high winds/seas**

This is the first message I had been able to leave since yesterday afternoon. At 5:00 PM Gavin Marshall, Fred Belton, and I were taken back to Braveheart. The boat was in a northerly swell, rolling rather violent, so the skipper opted to pick up and move towards Spit Bay. That was actually part of our operations plan. The weather window was optimum, and so we did a night run in one day.

At this moment we are at anchor off the count South Coast of Spit Bay. It is 10:12 AM. The wind is around 40 kt, maybe 30 kt gusting to 40, maybe a little higher. There are whitecaps. This is not a calm sea. It is not workable to go into Stevenson Lagoon at the moment, so we're just waiting to see whether the weather would calm down.

The plan is that if the weather columns down we would get into Stevenson Lagoon and explore the areas that we had identified before, including the streams and the lagoon and the areas around the glaciers.

I have been away from Atlas Cove so I don't know the news from there at the moment, but

perhaps that can be seen on the vk0ek.org blog website.

8:38 Braveheart at anchor S end HI in high winds/seas

It's about 138 in the afternoon. We're still at anchor down on the south shore near Spit Bay. It's become foggy, visibility 100 m or so, wind about 30 kt or so. Conditions have not improved and we're just hanging on and waiting.

4/5/2016 3:22 At anchor vicinity Spit Bay. Plan to inspect lagoon, coast.

It's about 8:21 in the morning 5 April.

We are still at anchor off the South Shore near Spit Bay. The sea has calmed quite a bit and the air is clear. We have a magnificent, absolutely stunning, view of big Ben from the southeast corner of Heard Island.

The gap into the Stevenson Lagoon is clearly visible and it looks navigable, so we're preparing within the next hour to launch one of the boats with Gavin, Fred, and myself. Gavin Fred will go up to the tarn to see if they can document the rockfall and the inlet, while I will hang around shoreline to document the subsurface stream from the tarn and collect some specimens that might show the first marine colonizers of the lagoon. So it will be a couple or three or four hours, maybe more.

4:41 Gearing up to inspect Stephenson Lagoon and Spit Bay

It's 9:41 AM. Standing off of spit. We're now loading the boat to go over to Stephenson Lagoon. Gavin Marshall, Fred Belton, and myself, together with the boat's crew.

It continues to be a spectacular visiting visual experience with the sun shining on the southeast side begin to see is workable but not comfortable. We're going to be gone for somewhere between one and two hours, and then come on back

9:57 Report from inspection of lagoon and Spit Bay coastline

I am very happy to report that we succeeded in getting into the Stephenson Lagoon, going in through the south entrance. It was calm inside.

We landed first at the outflow of the stream from the tarn. Gavin and Fred then stayed at that place and climbed up to document the tarn. I walked up the beach, documenting the subsurface stream that we believed comes from the tarn, although apparently it comes from under the glacier terminus, from an opening only about 1 ft. high and 20 ft. wide.

I then went with the small boat on an inspection of the shoreline, including the remnant terminus of the Stephenson glacier, collected samples of the water and the shoreline on the opposite side of the lagoon. Various samples included rock cobbles, sand, and organic animal waste.

We then picked up Gavin and Fred, and used the bottom grab from the geological survey to obtain a sample of the sediment in the bottom of the lagoon.

From there we traversed to the NE corner of the lagoon and inspected the north entrance and possibility of carrying out the radio operation from Spit. It was obvious that it was impossible, due to high surf and rough coastal rocks.

We picked up everybody, stopped at a very large penguin colony right at the entrance to the lagoon as we positioned ourselves to get out. It was a very, very rough exit. The low tide and high surf was pounding and only due to the exceptional skill of Braveheart crew did we make it out of there.

Now we're back in Braveheart and back into dry clothes, and we have had some soup.

We have some samples, not in the volume but in the diversity that we planned, so we can call this a great big success. It was a huge effort but it would extremely valuable.

14:41 At anchor off SE coast, S of Spit Bay

It's a little after 730 in the evening. We are still at anchor off the southeast coast just south of Spit Bay.

As the sun went down we were treated to an almost indescribable brilliant orange sunset all around the island. The atmosphere cleared so we had a complete view. It was not obscured by clouds anywhere, so we could see Mawson Peak and we could see smoke coming up out of the narrow pointed vent on the summit of the island. So altogether this was an extraordinary day.

The crew of Braveheart also felt very pleased and satisfied. This was a challenge.

We celebrated with a party on the back deck with something called gin and tonic in a glass with glacial ice. Maybe the ice was 150 or 500 or a thousand years old, but it was very good–nice and clear. It had a few gas bubble inclusions, and it was very hard, but it tasted very good.

This was an experience that very few people have had, a very successful day. I've been through the specimens to make an index. I can say that the goal of getting to Spit Bay in obtaining specimens and photographic documentation has been achieved.

We are accompanied by hundreds of seabirds that live here.

We're all pretty tired getting ready for dinner. It's dark outside. Now and then we glanced in the direction of Heard Island, we perhaps hoping to see a little glow of light, perhaps some hot lava coming out of the vent cascading down.

4/6/2016 2:49 **At anchor off SE coast HI. Prep. to return to Atlas Cove.**

It's 7:48 in the morning. At this moment we are still at anchor off the southeast corner of Heard Island with a magnificent view of the mountain. It's a little foggy today; last night was blazingly clear. This morning the top of the mountain has irregular clouds and some fog, but we can see the mountains pretty clearly.

Braveheart is getting ready to weigh anchor and return to Atlas Cove Corinthian Bay Area. Should get back about midday today. Gavin, Fred, and I will rejoin the crew at Atlas Cove. We have not had any news from them directly or indirectly, so we're not sure whether the radio operation has proceeded.

10:41 **Arrival back at Atlas Cove.**

It's about 3:40 in the afternoon. We have just arrived back Atlas Cove. Skipper and crew are looking for the appropriate place to drop anchor. It was kind of rock 'n roll return on the south and west side of Heard Island. Got kind of foggy. Could not see much. Considering the exhausting effort of yesterday, Gavin, Fred, and I are taking the opportunity to get a bit of nap, but once we get it anchor will go ashore and readership rejoined the team and carry on.

11:45 **Return of field team to VK0EK campsite.**

It's about 4:45. In a few minutes Gavin, Fred, and I will be taken off Braveheart and go back at the camp on Atlas Cove, so I will update you from there.

It was actually rather clear up until the last 20 min. when it fogged in again and got some overhead. This wind is calm and the sea is calm.

I spoke with the guys on the island about a half-hour ago and everything seems to be fine with them–no disasters anywhere

4/7/2016 5:54 **Details about visit to Stephenson Lagoon and Spit Bay**

It's not quite 11 o'clock AM at Atlas Cove. I want to give a slightly more detailed account of our experience at the other end of the island two days ago now. I provide this description because some people asked for more details about it, including the AAD, so we are pleased to provide these details.

On the trip down to Spit Bay we had ridden about 10 foot seas all the time. Then on April 5 there was a very short break in the weather. We could see what was happening on the weather map, which indicated a break of about three or four hours or so. We took that opportunity to take the small boat into the Stephenson lagoon to survey and collect specimens.

While we were in the lagoon we were able to go over to Spit Bay shore where we had considered a radio operation. Observing it from two vantage points, it was clear there was no option whatsoever of approaching the area to set up a radio operation. Furthermore, Braveheart crew determined that the anchorage and the surf on the north coast of Spit Bay, on the outside, was unworkable, and as we were doing this the weather started to close in, so we had to complete our observations and get out of there.

So it was very clear that there was no question about any further operations there. It would have been totally impossible to conduct a radio operation at Spit Bay, involving carrying radios, antennas, generators and gear over that section would have been essentially impassable. Furthermore the permit that we are operating under would makes it impossible for us to transport the gear back and forth. We have a one-way permit and it would not have been possible to go back and forth. So the reconnaissance of Spit Bay area showed that it was clear that under the conditions, including topographic, weather, and surf conditions that no radio

operation could have been done from there. We had only a few hours. We got back on the vessel and rode out the night under very stormy conditions.

4/8/2016 **No log**

4/9/2016 9:45 **WX report. Rain, wind, flooding. Begin packing.**

It's Saturday about 2:44 in the afternoon. The weather has turned sharply. We are getting a lot of rain and wind. The Nullarbor area is completely flooded. The forecast is for high winds and rain tomorrow.

We are packing, the serious beginnings to get out of here. If we are unable to get out of here tomorrow it may be impossible to get out until much later. Two of the antennas were knocked over by the high winds so we are pulling up stakes and we are dismantling the other antennas. Ops are still working some of the bands calling for ATNOs only and getting ready to pull out as quickly as we can.

STRIKING CAMP AND PACKING

4/10/2016 6:04 **Flooding. Braveheart in 15-ft. swells. Team photos with flags.**

It's about 11 o'clock in the morning. The flooding is still out there so we can't move equipment to the beach.

Braveheart reports that they are in 15 foot swells, so they are not going to send the boats to shore today.

A little while ago Carlos and I were able to raise the national flags to prepare the team for photographs. There is no possible way to get the team together for other photographs. Just as we finished it started hailing. It was a brief but hard hail and it hurt. We are still working the radios but the propagation is terrible so the QSO count is rising but very slowly.

We do appreciate that everyone appreciates how difficult the conditions are here. Mechanically it's quite a challenge and it's getting tough, so we're looking forward to having a break when we can get our gear off the island, get back on the boat and on our way home.

11:49 **Dismantling, packing. Anticipate striking camp tomorrow.**

It's about five o'clock in the afternoon, and we're well into the process of dismantling and packing to leave. We were unable to get a visit from the boat today. There were huge seas and swells out in the Cove so we have spent the day pulling down some of the antennas and packing things in boxes, getting ready for the big day tomorrow when we will try to pull everything down.

We have two radios operating at the moment, on 20 m and 40 m, but when the higher band goes out this evening we will stay on 40 m through the night. In the morning that will be shut down and will be QRT.

16:24 **Shutting down, packing. No tent heaters. 75,000 QSOs.**

It's about 9:22 in the evening. We worked most of the day taking down antennas, rolling up coax, and now we have shut down most of the stations and packed them in the green cases.

Weather permitting, Braveheart will come over early tomorrow, and we'll start moving gear. The goal is to get everything completely off of the island tomorrow.

Right now there is very mild breeze, but it's very, very cold. We don't have any heaters in the tents, so we're all bundled up.

We had one station operating on 40 m through the night. The total number of contacts we have logged will be about 75,000.

This is been an amazing astonishing glorious adventure here for us, but we will be happy to get back on Braveheart where we can get cleaned up, relax, and enjoy what we've done here. We have a lot of pictures and we look forward to sharing them.

4/11/2016 6:59 **Striking camp; one tent down. Expect exit this afternoon.**

It's 11:58 on Heard Island. We are striking the camp: we have one of our shelters down. A good part of our material is being transported to the beach for the boat. We are probably within less than an hour of striking the other tent. From that point on it's small stuff such as pulling stakes, the generators, and so on.

We got a break in the weather, although it started hailing again today for about 5 min., but the sky is covered with puffy clouds so we cannot see big Ben. We do have a spectacular view of the

Lawrence Peninsula.

8:36 Campsite packing nearly completed. Hail storm.

It's about 1:35 in the afternoon. This is an astonishing sight. The campsite is almost all packed. Probably one or two more trailer loads. Both tents are down and wrapped up in their bags. Nothing but personal gear and the tents left to transport to the beach. And a couple of barrels of debris. We had a little hailstorm today. Otherwise it's been clear, cold the bit of wind, just lovely site.

So tonight and our two will all be on the boat and out of the wind.

9:29 Campsite completely clean and we are leaving.

It's 2:29 at Heard Island. We are leaving. We are walking away from our campsite. It's completely clear and clean. All of our gear is either on the boat or on the beach. So the 2016 Cordell Expeditions to Heard Island is closing shop. Bye!

DEPARTURE FROM HEARD ISLAND

4/12/2016

5:24

All crew and cargo evacuated. Braveheart has left HI.

It's about 10:23 in the morning. We are on Braveheart, about 130 nautical miles east of Heard Island. The entire team and all of the equipment was evacuated from Heard Island last night. By about five o'clock everything was back on board. It took a total of about nine hours to strike camp and carry everything out, and by nine o'clock the crew had secured all the items on board and we sailed out of Atlas Cove away from Heard Island.

Most of us just collapsed into our bunks and passed out. I personally slept for 12 hours straight through. We're in seas of perhaps 6 or 8 feet, a bit roly-poly, overcast, whitecaps, but we're quite safe, and moving on the path.

It will probably be a little boring but I will make reports as we go along.

4/13/2016

No log

4/14/2016

4:44

Cruising toward Fremantle. Team resting.

That's about 9:43 AM. This is the first time I've been able to make a log entry. The Iridium phone has not been working, but it is now. I

t's been pretty quiet. We're about 600 miles from Heard Island. We made a course change to go north, to get into Calder wind area, and it's been a pretty good ride for the past eight. Last night was pretty calm, pretty easy.

The team is pretty much resting, sleeping, sorting their pictures, talking, sharing the adventure. The vessel crew takes shifts, prepares food for us, makes life very comfortable for us.

4/15/2016

8:13

About halfway toward Fremantle. Sea state reasonable.

It's about 2:12 on Friday. We're about halfway from Heard Island to Fremantle. The seas are pretty roly-poly, maybe eight-foot seas or so. Overcast. The boat rocks a fair amount so we have to be very careful walking around. We do get real nice lunch and dinner. Pretty much everybody is staying in their bunks or sitting on the bridge looking at the ocean, but there's not much else we can do, because the mechanics of just staying upright, moving about, or even staying at the table, is pretty difficult- it's rock 'n roll here.

4/16/2016

3:49

Continuing underway. Rough seas last night.

It's about 9:47 Saturday morning. Not a lot to report-ot much changing. We're moving along, approaching halfway between Heard Island and Fremantle. Last night the sea was up. It was a banging time with the boat rolling around. Early this morning it calmed down quite a bit, so right now we have relatively calm seas, and we can stand up and walk around. Other than that, there's not a lot of news.

We're processing some of the specimens we collected, and talking about what gear we will offload at Fremantle, and the procedures for Australian customs, quarantine, and so on. One member of the team, Alan, lives in Perth, so he will be arriving home. The rest of us will spend one or two nights, and then on Sunday, April 24, six of us are flying out. I personally am going to Sydney to spend a couple of days with Grahame Budd, the legendary explorer Heard Island.

4/17/2016

5:31

1000 nm from Fremantle. Live satphone call to the Intl DX convention IDXC

It's about 1128. We're about 1000 miles from Fremantle, with an ETA sometime on 22nd of April. We're at 40°41' south, 98°52' east.

Earlier today I called into the International DX convention in Visalia, California, and was patched in to address the 500 participants there. Rich KY6R was giving the talk about the Heard Island expedition and by plan I called in, interrupting him, and had about 5 minutes to report the success of the expedition.

Here are a few comments that I made on the call: We were on Heard Island for 22 days, during which we logged about 75,000 radio contacts. From the moment we landed on the island until we went on the radio was 15 hours, an amazingly short setup time. We logged almost a world record of 3200 QSOs on top band. We fulfilled most of the scientific goals, including photo documentation and specimens. We probably were the first to enter the Stevenson lagoon, located at the opposite end of Heard Island from Atlas Cove. Some years ago this lagoon was a glacier, but it retreated due to global warming and is now a lagoon.

While we were on Heard Island we had several interviews by Skype, including with four different schoolroom classes.

We had kind of a rough night last night, hanging around, and we're happy for called season three get

4/18/2016

No log

4/19/2016 10:59 **Calm seas, easy ride. ETA Fremantle Apr. 22 AM.**

This is been a very pastoral day. It has been very calm, a nice ride most of the day.

The team has scaled down their energy and are resting, sorting through pictures. We have literally thousands and thousands of pictures [eventually it was counted as 25,000]. I have compiled about 150 core pictures from the team and I'm not finished.

We are about 430 miles from Fremantle with an ETA on April 22 Friday. We will be staying in the hotel Friday night and Saturday night, and attending a party by hosted by the Northern corridor DX group Saturday night. This has been a quiet restful day, a nice boat ride.

4/20/2016

No log

CONCLUSION

4/21/2016 22:54 **At dock in Fremantle. Beginning customs, unloading.**

Just before 7:00 AM. We are tied up at the board in Fremantle, Western Australia

The weather is calm. It was a pretty quiet ride in and we're just now beginning the process of getting oriented for the customs, immigration, and other procedures. This will probably take half a day, perhaps to three o'clock in the afternoon, before they set us free. Then they will take us over to the hotel in Fremantle where we have reservations for two nights.

So tonight will be the celebration with a group, and tomorrow the barbecue reception with the northern corridor radio group. After that the team starts leaving and we're going home.

4/22/2016 4:28 **Expedition cargo unloaded. Specimens cleared.**

It's about 12:27 in the afternoon. We're sitting in Port in Fremantle. We have cleaned and unloaded all of the expedition cargo, including the tents that are going to HDT and our personal bag bags. The specimens that we collected on Heard Island have been cleared by customs and quarantine, so we hammered the lids on the buckets closed. Two buckets of rocks are going to the University of Tasmania and two buckets of soil and water are coming back to the U. S. Geological Survey and ultimately to Cordell Expeditions.

Part of the team has already moved over to the hotel couple miles and the rest of the team is relaxing on board.

10:01 **Team in hotel, resting, cleaning.**

The entire team is off the boat and all of our equipment is unloaded. We are safely ensconced in the Esplanade Hotel in downtown Fremantle, across from the marina. Most of us will be here for two nights, through Saturday night. I can tell you that it feels so good to take a hot shower. Of course we had that on the boat, but we were so cold so much of the time that it was like heaven coming to a hotel room and taking a hot steaming bath and having a stable floor under her feet for the first time in many days. Everybody is feeling very good although everyone was so tired from offloading the boat today that most of us just fell into a nap in the hotel. In a bit I'll walk downstairs and meet up with the team and the crew for a party—we're going to have a jolly time!

4/23/2016

No log

4/24/2016 0:05 **BBQ party by NXDXG. Leaving Fremantle.**

We had a fabulous time with the Northern Corridor DX Group last night. Most of the remaining team were at breakfast this morning. I'm in Perth on the way to the airport. At this moment I'm being driven to the airport by a team member Alan VK6CQ and his lady Kim.

So at this point I think I can declare that the formal events for the 2016 Cordell Expedition to Heard Island are concluded. We think everyone for their interest and their contributions, and will see you on the other side.

5/6/2016 23:45 **Final Expedition Summary**

Gavin Marshall journal

During the visit to Heard Island Gavin Marshall kept a detailed log. It is reproduced here in its entirety.

- 10-Mar Braveheart**
8am at Braveheart
10am – off to Immigration to get passports stamped and exit arrangements completed
After that we had 2 hours for final shopping, lunch and a coffee at Alfredo
2pm Pilot boat due to take us out of the harbour.
4:30pm pilot boat arrives and we head away from Cape Town
7:30pm dinner onboard and by 8:00pm it's all back in the bucket !!
- 11-Mar Braveheart**
Slept well overnight but a few spits into the bucket at times. Changed to the Kwell medication as it seemed to be less severe on my stomach. Taking Kwell every 6 hours
Managed lunch and it stayed down all afternoon – quite celebration
Stayed in bunk all afternoon but returned for dinner and that to stayed down.
- 12-Mar Braveheart**
Managed a breakfast, lunch and dinner at no problems. The motion sickness is under control. I'm off the tabs and able to move about the boat. Still spending most of my time in my bunk because there's not much to do. I find the dining room seats uncomfortable.
- 16-Mar Braveheart**
Feel crap today. D and fever. Norafloxacin in the morning and the rest of day in bed. NO lunch and a small dinner
- 17-Mar Braveheart**
Fever passed and slept well over night. Fell good. Planning meeting for school programme and field science. Second buoy was launched today.
- 18-Mar Braveheart**
Poor sleep last night but feeling fine otherwise. Launched 3rd buoy today and at last I managed to be there on time to see it drift away. Phone call home.
Adam provide name of contact who is a guide on McKinley and also works at ALE in Antarctica – contact him again post trip to confirm name (Tim Hewitt?).
- 19-Mar Braveheart**
Same old same old...Good sleep overnight helped though
- 20-Mar Braveheart**
More of the same but spending time planning for HI landing. Sore throat developing - hope this is nothing serious. Few others on the boat are ill – Dave Farnsworth quite ill, has laryngitis
- 21-Mar Braveheart**
Great sleep – missed breakfast. Shower was great as well. Discussed with Fred Laurens Peninsula plan over a cup of tea.
- 22-Mar Arrival at Heard Island**
We will see Heard Island for the first time today. ETA is approx. 3pm this afternoon. Lot's of talk and last minute discussion on landing plans going on. We will get personal bags back this evening for a re-sort of equipment and will then commence transfer to HI tomorrow morning.
Outside is very foggy weather. I hope to see McDonald Island as we approach. In the end no views of Mc Donald as we approach HI from the North East and round Red Island and sail down the coastline into the Atlas Bay anchorage.
There is a shroud of mist over Laurens Peninsula. We get occasional glimpses of the interior of the peninsula at times but mostly all we can see is the coastal outline. The cliffs that drop into the sea on the eastern side of Red Island are enormous, even though we are approx a kilometre offshore we can see the white breakers as the waves crash onto the rocks.

As we come into the anchorage area a flock of Cormorants fly alongside Braveheart, keeping pace with the boat.

First impressions – Heard Island is very rugged and much larger than I had expected.

23-Mar Landing on Heard Island

5:25am start for breakfast and to prepare for first boat away to the island by 6am, in the end the first boat was about 6:45 am I recollect. Weather is amazing – calm clear with some small rain showers passing by occasionally.

We can see Big Ben from top to bottom, what a fantastic mountain, and much bigger and ominous than I had anticipated. Very steep sections of ice and many blue ice glaciers tumbling down from the flanks. Severe crevasse fields!

When I arrive on the island we are greeted by a small colony of King penguins that just want to get closer and find out what we are all about. On arrival at the green apple and tank shelters the team has already begun the search for the perfect tent site. The site closest to the shelters is soon abandoned and work starts on clearing a site further south toward the sand flats. The dimensions of the HDT tents are measured out onto the ground and tent stakes placed into the hard rock surface as close to the desired locations as possible.

The team from Braveheart are busy unloading as swiftly as possible, bringing our items in the required order. First the ATV, second the HDT tents, radio boxes and finally the personal equipment and living area equipment and beds.

Inflating the tents goes well, until an observant bystander notes the inflation appears to have stopped with the air beams on 1/3 inflated. We all ponder on this and within minutes we've located the source on the air leak, an internal bleeder valve can be heard letting air escape. Arliss makes a quick rescue effort into the folds of the tent and then we are underway again.

Within half an hour both tents are inflated and then begins the task on ratchetting tight the guy lines to provide the strength required to hold the tents firm in a strong wind.

The external floors go down, the tables and chairs brought inside and it's starting to look habitable.

While Arliss, Fred and I have focussed on the later stages of completing the tent setup the radio guys have been putting the first 2 ariels together in an attempt to meet a self imposed 6pm first transmission time.

Approx. 6pm Braveheart crew drop in and deliver the last load of equipment for the day along with a well received dinner for everyone.

First logged transmission is achieved 9:30 approx. and very sooner thereafter most of us have headed for the sleeping bags and a well earned sleep.

24-Mar Antennas and heater

Worked with Vadym on 60 metre antenna. This is a single 24 metre high aluminium pole fashioned from different diameter 2 metre approx. aluminium lengths, each held tight in the structure by clamps. It takes us about an hour to get all the pieces in place and clamps fitted. Next we cut the guy wires to four separate steel standard pegs and then we make an attempt, with the help of 3 others to pull the pole upright but the winds are just too strong and creating a bend in the pole that we can't overcome. As darkness starts to fall the decision is made to bring the pole back to the ground and try again the next day.

Tried to get heater running before second heater was brought in

Bed at 11pm after loading photo's from day 1 and journal entries.

25-Mar Day trip 1 - Laurens Ithmus

Rain to start the day. Spent the morning on housekeeping items and preparing for a day walk in the afternoon.

At 1pm Fred and I left for a walk toward the narrow neck of land onto Laurens Peninsula and return. An amazing afternoon – every where we turned there was something new to explore (all documented in the afternoons photo's and video's), a bullet point summary:

Bones scattering the beach from seals, sea loins, penguins and skua's

King penguins, cormorant, small white / black Gentoo penguins

Skua that would fly direct to us and then almost hover on the wind only a few metres from us before landing

Ocean debris; some personal items (plastic bottles), fishing rope, fishing float, weather balloon transmitter, cigarette lighter

Elephant seals, fur seals, leopard seal

26-Mar Day trip 2 - Nullarbor, Kildakelly Head, Schmidt Glacier, Erratic Point

Today we are aiming to go as far south into Zone B as we can. We left Base Camp at 0815 and headed south. Fred and I made an agreement to leave cameras untouched until we were across the ground we had travelled on the previous day as we knew more photos opportunities would just slow us down. I'd like to say we stuck to the agreement but NO. By the middle of the Nullarbor we were snapping away again.

At the base of Mt Andre/Nullarbor we were greeted by the King penguin group that appeared to be the local residents – more photos.

We continued on and were soon at the northern end of South West Bay where we stopped to take in the view. The bay stretched out to the south, the wind was coming in from the west, the waves were crashing in on the shore and the misty rain was creating an eerie view of the southern headlands of Kildakelly head.

We spent time watching a group of huge male elephant seals that had hauled out onto the beach at the base of Kildakelly Head and then we continued our walk further south. We crossed a small glacial stream and observed several very small fresher water outlets that just disappeared into the sand.

We crossed the Schmidt glacier stream right at shoreline where it spread out into many small flows and continued south to Erratic Point. I was very interested in photographing in this area as I knew it was one where Grahame Budd had shown a lot of interest and had had me several photographs of the same area. In the end I'm not sure if I managed matching photos to his but I have plenty to compare with him. The surf at this point was quite rough – smashing onto the large rocks 10-20 metres of the beach. Fred and I completed a count of bottles and other debris items on the beach and then followed a penguin trail around the point into a small gully.

At this point I felt physically sick! I was surprised how badly this affected me but here we saw the impact on Heard Island from those many 1000's of kilometres away. The gully was awash with waste. In a 30m stretch we counted –

- 55 600mm – 1.5l plastic drink bottles
- 7 cleaning product plastic bottles
- 1 very large plastic flows (1m circumference approx.)
- 1 large marine float with antenna
- 2 polystyrene floats
- 1 gas cylinder

The good news from this location was that we saw out one and only (to date) Macaroni penguin. We came across this little guy as we climbed the ridge (old moraine) out of the gully. He sat all alone on the very edge of the 5m drop down to the beach looking seaward. It was almost as if he were asking “how did I get left behind? Maybe he was sick and unwilling to take the plunge and go to sea? After many photos and video we continued on to the top of the ridge.

Cresting this ridge brought even more “new” views to comprehend. There was a Gentoo rookery to our left (inland) approx 100m and 300m approx further south was the Vahsel glacier.

Fred headed directly down to the beach while I took a short detour to the Gentoo rookery. There were “chicks” in residence, they were easy to spot as they were still dropping down but they were shy and turned away as I neared.

Grey/black and white – they were the overriding colours in this landscape. The grey of the beach sand and rock and grit of the moraine debris on the ice, the white of the glacier ice. And amongst all this, the flashes of gold of the King penguins.

We turned inland and followed the stream back to the first of the lagoons that we had seen from the ridge. The King Penguins were here and made great photo subjects with the glacier as a backdrop.

Further up the stream we came to the next lagoon with small icebergs floating in it – more photos!

We turned north here and regained the ridge line that was the edge of the glacier moraine wall in some time past.

We were in a new world again. Lush green moss, Azorella plant that flowed over rocks like waterfall and Kerguelen Cabbage. It was sensory overload – we had seen and experienced too much since leaving camp. We were in an area that formed a small basin area – we were sheltered from the light wind and could see north to Atlas cove and Braveheart was just visible anchored in the bay.

I convinced Fred that I had to “summit” the small rise to the west that was approx 50m away so took off for the short walk I expected it to take. Once on top I saw another higher point and off course continued on. This led to a short ridge running north / south so I took the short walk to the end of that – and what surprise. As well as the HUGE views north to Atlas cove I now had a view to the east, a lush green valley with several streams running down it from the Schmidt glacier. And at the base of this cliff was a large penguin colony. This was a no brainer – we had to descend and make a detour up to this valley.

We slipped out way down the northern side of our ridge, crossed a freshwater stream and made a small height gain over kilometre (approx) distance to the penguins.

This was a real penguin experience – thousands of king penguins and chicks from this years hatch with their brown down still to shed. And the smell was overpowering. We spent about an hour watching the penguins before we set off for Base Camp. This required us to return to the West Bay beach to pass the glacial stream, cross the Nullarbor and then the final stretch into Base camp.

27-Mar Day Trip 3 – Corinthian Bay.

We had planned to get away early and attempt to get as far west into Zone B as we could.

Early morning and it was apparent that our plans were going to be amended as we had strong winds and rain from the west and so we decided on “tent time” and to reassess later in the morning. I spent the time on admin, charging batteries, editing some photos for dispatch back to Dylan.

By mid morning it was apparent that the winds had reduced, the rain had stopped and we would be able to get out of camp.

Day Trip 3 – from Base Camp over to Corinthian Bay. Our objective was to get more of the light/temperature sensors in the field.

On departure wind was very strong and Fred Arliss and I were fortunate that it was coming from behind us and we made good time over the relatively short distance to the western end of Corinthian Bay.

We visited the site of the old sealers station – the tripods were still there and a stone wall and timbers plus a myriad rusting steel pieces lying in the sand.

We walked east across the bay. Many King Penguins, a few Gento and many Elephant seals plus one Leopard seal.

At the eastern side of the bay our path was blocked by the glacial stream coming of the Baudissin glacier. There were a number of young seals playing in the stream. Mouthing each other, rolling and dunking each other. Also a small group of King penguin and 3-4 Gento's

We turned south and followed the stream inland where after approx. 200 metres we came across ice caves in the fallen glacier ice and from here we took a water sample. We travelled another 200m approx inland before deciding to return to the shoreline and retrace our steps back to the western end of the beach and deploy a temperature sensor.

The walk back was very interesting as the winds had increased to the point where a fine sand storm had develop. The seals were hauling themselves back into the seal, and the King penguins were heading back to the main group on the western side.

We struggled back to camp. The sand was direct into our faces and the sand particles were like needles. For me a combination of hat pulled down and buff pulled up to create a small viewing slit was the way to reduce the hurt and make it back to camp.

28-Mar Day trip 4 - Walrus Bay, Mt. Drygalski

A dusting of snow overnight.

Fred and I went out and summited Mt Drygalski a low (222m). We left 8:20 and returned 14:40. Once again we walked the south shoreline of Walrus Bay and when we reached the southernmost point of the bay we turned east. There is a rock finger (200 metre long by 50 metres wide approx.) that reaches out into the Nullarbor from the slopes of Mt Drygalski and that was the first simple objective. The terrain underfoot is a mix of sand/silt and lava pebbles/rocks with an occasional lava outcrop to walk around. Very soon we are on the lower slopes and making good progress. These slopes are also a mix of lava pebbles and rocks but before too long we are onto the higher slopes that have been overrun by the Azorella plant. Azorella tumbles down the hillside like a waterfall, covering everything in its path. It's very spongy to touch and obviously absorbs a lot of water as a push by hand results in a flow of water to the surface.

Mt Drygalski is a simple 226 metre climb but it is made more difficult by the wind that comes in from the south west, directly across the Nullarbor and today we are going to get a good taste of it. On reaching the summit we are in winds that are blowing Fred off his feet and he elects to take shelter in the lee side of the summit and photograph from there. I complete the extra 4-5 metre climb and achieve my first summit on Heard Island!

Rather than head straight back to camp we continue along the ridge line that heads south east toward the Schmidt glacier, it's approx. a 500 metre trek and the terrain is quite easy to negotiate. From the south eastern end we have great views down onto the King Penguin rookery that we had seen the previous day and the up onto the Schmidt glacier itself. There's a ridge line of moraine gravel between us and the glacier just begging to be climbed so I agree with Fred to meet him down in the runoff valley just behind us and I make my way up the ridge. It's a very simple climb, knife edge ridge and a tail wind so very little effort required, except to stay balanced in the wind! And from this ridge I can no longer see the terminal face of the glacier and the two small lagoons that are at its northern and southern edges.

I spent a little longer standing and taking in the amazing view than I'd anticipated and when I tried to locate Fred in the valley behind me I couldn't see him anywhere. He'd also been unable to see me for a period of time (I'd sheltered behind a rock for a few minutes to get some food) and so he'd also come up onto the ridgeline.

The previous day while in Corinthian Bay I'd noted that there appeared to be cliffs on the northern side of Mt Drygalski that fell away into the Baudissin glacier so on our walk out we stayed high on the slopes to avoid any chance of getting bluffed out.

We took a food stop along the way out and noticed a very prominent "red scar" on the hillside from which we took a rock sample before continuing north, and lower on the slopes.

Our final exit of Mt Drygalski was a "running plunge" off a 10 metre sand bank to the sand flats of Walrus Bay.

I spent the end of the day trying to catch up with the admin – fb posts, time lapse video of base camp setup.

29-Mar Day trip 5 - Walrus Bay

Day walk around to Rock Hopper and Macaroni penguin colony on west side of Walrus Bay with Jim.

I wanted to investigate using the shoreline on the southern side of the narrow neck of Laurens peninsula as a means of accessing the northern end of the peninsula. Jim and I also decided to have a look in at the penguin colony that we had seen on the western side of Walrus Bay.

The penguin colony was a mix of Rock Hopper and Macaroni penguins and reached quite high up the hillside. We climbed higher up the hillside to photograph the penguins and came across a very protective skua that wasn't going to move. As we got closer it was evident why – there was a penguin skeleton outside of the nest and was obviously worth protecting.

At the top of the cliff we found ourselves in a very deep and wide expanse of azorella. We headed off to the lower slopes (southeast) and came across a Giant Petrel colony. The adult birds were

Preparing food and equipment for Laurens peninsula

30 March – 2 April Excursion 1 - Laurens Peninsula

At 1:30 approx Fred and I are being picked up by Braveheart crew in zodiac's and will make our way north to Sydney Cove at the far north of Laurens Peninsula. Our initial plan is to stay 3 days with a mid afternoon pickup on the last day. We'll be self-sufficient, taking all food and tent in the event that we find Laurens Peninsula apple is uninhabitable.

The boat ride north to Sydney Cove was a fantastic event for those not regularly involved with the sea. Small open boats, a small swell and a crew that were more than keen to provide a memorable ride. The wind was from the north west so our travel along an easterly coast was plain sailing. We speed between the swells and frequently there was enough swell height to have us crash down on the falling swell. It took about 20 minutes in the zodiacs to reach Sydney Cove and we took one directly onto the beach for me to clamber out before the crew noticed an inlet that provided an entrance to a very sheltered lagoon. While I was looking for the "apple" to confirm we had a home for the next 3 days the crew unloaded our packs and bags on the shore.

The apple had not seen human use for at least 15 years, we think it was last used in 2000, and we had a question mark in our mind about whether it would be still serviceable. The apple is located on the second plateau above the shore and on opening the door to check it out we had only one apparent issue – the door had fallen off!

The hinges had corroded and the action of me opening the door had caused the pins to sheer. We had an operable door as long as we could man handle into position to open or close it, not a big enough issue to make us use a tent anyway.

Billy and Elliot from Braveheart crew had carried several of our bags to the first plateau, Fred had his back pack at the apple so we were making good progress by the time Braveheart crew left us with the promise to be back for pick up on Sunday afternoon at 3pm.

For the rest of the afternoon Fred and I completed the multiple carries required to bring water and personal equipment from the shoreline and plateau to the apple. By early evening we were dining on our Back Country dehydrated meal pack and making plans for the next day.

The weather forecast we had from Thursday suggested we'd be experiencing strong winds from the north west so we decided that if we could get outside we'd operate in the area of apple so we had the option for a quick retreat if necessary.

Come the morning we had blue skies and a light wind. We were out and about by 8am and stuck with our plan to work around the Sydney Cove area – focusing on the 3 plateau's that ran parallel to Disappointment Gully and the eastern cliff line.

We walked down toward the eastern end of the top plateau and worked, it wasn't long before Fred was taking his first rock sample. We continued independently knowing we had radio contact between us if required. I walked as far east as I could to the cliff line that dropped into the sea.

Big, harsh cliff lines all around me. Those dropping into the sea are lava rock with sharp edges and very difficult to stand or walk on. To the east are the massive 2-300 metre high walls of Disappointment gully. I remembered back to pre expedition planning in Sydney when I'd thought that clambering down those cliff lines was a possible option!

Azorella plant and moss covered a lot of the plateau and several small streams flowed from the higher ground toward the sea. There was also a larger glacial stream picking up the melt water from the glacier on the eastern side of Mt Dixon and bringing down to the sea.

We spent several hours walking in this area getting our first experiences of Laurens Peninsula. By midday we had wandered back to the apple and took the opportunity to heat water and prepare some 2 minute noodles before getting underway on our underway excursion.

The weather was starting to lose it's appeal, there was a light mist starting to drift across the peninsula and the wind was lifting in speed, nothing uncomfortable but definitely noticeable.

We walked to the south of the apple, up and through the black and grey moraine rock. We had no definite plan of direction or end point, we just took the time to get a feel for the area. The moraine gravels formed a twisted pathway of interconnecting humps and hollow, at one point we appeared to have hit on an old stream bed and that provided an easier walkway but it to came to end after a short distance. By mid afternoon we'd gained approx

100 metres and collected several more water and soil samples to our collection. We'd also discussed plans for the next day and decided that we'd make an initial attempt to climb Mt Dixon by cutting across the aa lava flow. We were back at the apple around 5pm and starting the task of boiling water to prepare another dehy. food pack for each of us.

7:35 am, Friday and we are leaving the apple. We flowed yesterdays tracks through the moraine gravel to yesterdays high point and then struck out west toward the aa lave flow. The weather was abysmal, thick flog shrouded the area and at times turned to light rain and the wind was coming and going but not uncomfortable.

The lava rocks underfoot roll and slide as we move slowly across them. Fred explained to me how the aa lava forms – it's essentially slab lava that has broken into smaller chunks as it cools and then also tumbles onto it's edges.

We've also come across very fine lava sand, some silt and the aa lava as we walk through the maze of rolling ground. At one turn we come across a small lagoon and stop for another water sample. The water is crystal clear and there's a very green algae on the bottom of the pool of water.

The second lagoon we come across is interesting in it's own right. As we disturb the rocks and sand at the water edge we can see the water and sand whirl pool and disappear into the lava flow below. It appears that the silt and sand has congealed and allowed the water to pool but once we disturb it, it's flowing through the porous lava rock below. I tried jumping across a narrow neck of water to a large rock on the other side, on landing the rock sunk immediately and I was in water up to my thighs – it was like trying to exit a quick sand. I thrashed around and grabbed at rocks to get the leverage to pull myself out.

After 3 hours of walking we came across a reasonably long sandy stretch that dropped down away below low us and as the mist lifted slightly we could see the coast line. Complete disappointment – after 3 hours of walking in the aa lava maze we had achieved a net gain of 1km from the apple. It was obvious that we wouldn't be summiting Mt Dixon today.

Our decision was to return to the apple, making the return journey an opportunity to gather new water, soil and rock samples.

Also, on the return trip to the apple I took the opportunity to complete a rece. for an alternate route to the summit of Mt Dixon. I chose a ridge line that I could see in the mist a completed a climb up the lava sand/pebble/rock terrain to a height of 415 metres. At the high point I was able to see that I was above the eastern and western tongues of the ??? glacier and that getting further west onto the ridge we wanted to use as an access to the summit of Mt Dixon could possibly be achieved by traversing below the glacier tongues and avoiding the aa lava flow.

I took the opportunity to gather rock and soil samples from the high point and then dropped down the ridge to the moraine level. Here I took the opportunity to cross over into the glacier stream coming off the ??? glacier and collect samples before returning to the apple.

By 5pm I was had rejoined Fred back at the apple and we had started the ritual of preparing the evening dehy. food meal.

Next morning we made an early start and were walking by 7:20am. We completed the walk through the moraine and as the day was clear we were easily able to pick out the route we wanted to take to avoid the aa lava. We made a small height gain up onto an northerly ridge and then dropped down into a glacial valley that was fed from the ??? glacier. There had obviously been a large flow of water down this valley at some time as the stream was within a very deep gully that deepened further down the valley. We crossed the stream, climbed the opposite side moraine wall and reached a ridge that gave us access to a much higher point on Mt Dixon. From here it was a slow, measured slog on up the ridge. It took us about an hour climbing to reach the top of this ridge and start a traverse.

We weren't on the ridgeline that we needed to be on to make the summit and this made the traverse a necessity. We had almost clear skies, well for Heard Island anyway. There was a build up of cloud to the west but the winds were steadily building.

The terrain underfoot was deteriorating as well. Rather than the packed sand/silt rock combination that we'd experienced on the ridge we were now on loose lava pebbles and it was the typical 3 steps forward, 2 back/down that we were experiencing. Fred wasn't comfortable on this terrain and the wind was also causing him problems.

We continued on for another hour making the traverse. We were at approx 400 metres

altitude and I was quite happy with our progress.

By the time I made another 100 metres traverse it was obvious Fred had decided “no further”. He’d dropped back and was sitting in the shelter of a large rock taking a break from the high winds we were experiencing.

What to do? I was feeling good, the summit was about 250metres above me but probably 2 hours walk away. Despite my optimism there was only one answer I could accept – it was time to turn around.

Fred had said to me that he was OK if I carried on but I knew that (a) he was unlikely to sit in the one place for the next 2 hours and stay warm (b) if he moved finding him again would be a serious undertaking.

So we reversed our traverse and then rather than follow the ridge down we took an alternate option and dropped down via a sand slide face into the valley. We took the opportunity to gather more water, sand and soil samples and then returned back to the apple by retracing our steps. We were back in the apple by about 2pm.

For the remainder of the afternoon we agreed to split up and take a walk around the Sydney Bay/lagoon area. We still had good weather, sunny and low winds – a complete reversal to what we had been experiencing on Mt Dixon.

We now only had half a day before being picked up by Braveheart crew. Our radio sched. contact had confirmed the pickup time.

Heavy rain and misty, that was our introduction to Sunday 30th March. And there was no let up so we decided to stay in sleeping’s bags until later in the morning before re-assessing. A quick radio call back to Braveheart confirmed a 1:30pm pickup so we had plenty of time to decamp and get all of our equipment down to the foreshore for pickup. Around 10am we started on a light breakfast, packed all the gear and started the carry down the 3 plateau levels and across to the lagoon. The wind and rain persisted. By the 1:30 appointed time we were already to leave our Laurens Peninsula, it had been a fantastic 4 days in the area. I was “over” the miss of Mt Dixon summit but having seen such a pristine and infrequently visited area had been a real buzz.

We waited for an hour for Braveheart team to arrive. In that hour we were entertained by a young fur seal pup that was only interested in playing and I completed another plastic debris survey of 150 metres of coast line-

- 20 plastic drink bottles
- 2 cleaning product bottles
- 4 fishing net buoys

And then they arrived, Neil brought the zodiac into the lagoon and we quickly loaded gear bags and jumped aboard. Within 5 minutes we were whisked out of the lagoon, through the waves breaking at the coast line to rendezvous with the other zodiac waiting out at sea for us. I changed boat to join Billy and ?? and then completed the trip back to Braveheart.

And the new message was – don’t waste time, we’ll drop you to the Base Camp but in 2 hours time we are leaving for the southern end of Heard Island. I was struck the jackpot – I was off on another Heard Island adventure.

3 April – 5 April Excursion 2 - Stephenson Lagoon

We sailed from Atlas Cove on the evening of 2nd April and arrived at the southern end of the island early on the 3rd. Once again bad weather delayed our plans and we waited out a strong southerly wind, 50 knots – gusting above 60 knots for the next 24 hours.

On the morning of the 4th the sea swell was reduced, the wind was still reasonably strong but the sky was clearing. Around 8am one of the zodiacs was put into the water and Neil from Braveheart crew. Within 30 minutes he was back alongside Braveheart and then decision was made that we were going ashore. This time we were fitted out in bright orange deck suits to keep us dry during the ship-shore transfer.

Another fairground ride ensued as we bounced from wave to wave. The last hurdle before going ashore was to cross the breakwater. At one stage Stephenson glacier reached all the way down to the shore, now the terminal face is approx a kilometre inland. And in its place is an enormous salt water lagoon that we speed across in the zodiac. At points the depth metre was showing depths of 100 metres.

Fred and I were dropped on the western side of the lagoon as close as possible to the small

tarn that's shown on the map. Our objective was to get water samples from the tarn, understand how it flowed through to the stream entering the lagoon as seen from the satellite photos and also collect various rock, sopol and water samples as we considered necessary.

Firstly, the connection between the tarn and glacial stream that flowed into the lagoon. The northern most end of the tarn is the closest point to the stream. There is no obvious stream that flows out of the tarn. I walked down and around to the glacial stream and it appeared that the water must be flowing from the lower levels of the tarn, down under the ice fall that is the nose of the glacier and then possibly coming with other glacier melt flows to create the stream that I was standing alongside.

Both Fred and I were collected from our work location and as the weather was holding we were taken across to the eastern side of the lagoon, once again at a breakwater, this time into Spit Bay. We spent 10-15 minutes on the northern side of this point in the lagoon and were able to assess the sea conditions in Spit Bay, photograph in most directions and collect a huge ice block refresh Braveheart freezer store.

From the northern side of the lagoon we progressed next back to the southern breakwater but stopped on the western side for photographs of the king penguin and elephant seal colonies.

And finally to exit the lagoon. The tide had been rising all the time we had been in the lagoon and now we were faced with a rather large breaking surf at the breakwater over which we had to cross. Neil made a preliminary run across the face of the breakwater, lined up the "ideal" spot and we went for it. This was probably the closest my wife has come to making a claim on my life insurance! We took a wave direct on and it washed over us all, and by the time I'd managed to get my feet and face forward again we were hit by a second wave full on. Once again I was off my feet.

We made it through and with only the rollercoaster ride through the swells left we made it back to Braveheart.

That night we were hosted by Braveheart crew to drinks on the aft deck – with glacier ice of course!

We stayed anchored of Stephenson lagoon overnight and next morning we set off to return to Atlas Cove via the western side of the island. For the first hour I was able to take photos of the glaciers but shortly thereafter the mist rolled in and we saw nothing more until we arrived in Atlas Cove approx 4pm in the evening.

6-Apr [No entry]

7-Apr Day trip 5 - Drone, Corinthian Bay

Day in camp

Flew drone for first time

Walked to Corinthian Bay with Adam

8-Apr Day trip 6 - Walrus Bay, Nullarbor, Drygalski Rock Peninsula

Trying to arrange shipping into Fremantle

Walked with Charlie around Walrus Bay, across the Nullarbor to South West Bay and then back across the Drygalski Rock Peninsula, the sand flats and into base camp.

9-Apr Day trip 7 - Mt. Drygalski, Schmidt Glacier

Walked with Fred and Jim. Went back up the lower flanks of Drygalski and to the northern most lagoon at the foot of Schmidt glacier.

10-Apr [No entry]

Jim Colletto journal

During the expedition Jim Colletto (“Jimiii”) kept a daily journal, which is reproduced in its entirety here.

- Mon (3/7)** Showed up at the Jo’burg International Airport at 8:00am (local), after 24 hours straight in planes and had to pass through customs to get to my domestic Johannesburg to Cape Town flight. Stewardess was kind enough to move me to the front of the plane so I could sprint off and hopefully be one of the first one in the passport line. Sadly, there were only TWO CUSTOMS agents working on this Monday at 8am, so when I arrived, there was a huge snarled line. It wound up taking me 3 hours to get through that line (when I only had two), so I missed my flight. **Sometimes Afrika wins.**
- Tues (3/8)** Expedition team is assembling on the Cape Town waterfront, a very quaint marina town, which reminds me of Monterey (CA). As part of our admittance on Heard Island, the Australian Government demanded we complete “bio processing,” where everyone and all gear had to be cleaned with a fine tooth comb, or a fine wire brush in my case to ensure no foreign matter lands on Heard Island. Turns out our Antarctic-tested tents, which had been donated, were actually USED, not NEW as we had originally anticipated. So I and a small group had to clean them with wire brushes to remove all foreign matter. This took the better part of the day and reminded me of my time in the US Coast Guard when I had the pleasure of cleaning toilets with tooth brushes. **Ahh, life lessons!**
- Wed (3/9)** This was what I’ll call our mad-scramble day, where the team broke up into small groups and chased down last-minute items. As I had assembled the snacks and miscellaneous grocery list, I went to Pic ‘N Pay Cape Town Waterfront, where I had established a relationship previously through e-mail correspondence and was promised a “great deal!” Other teams went to Cape Union Mart (REI equivalent) and Builders Warehouse (Home Depot equivalent), as the most pressing item we faced was propane camping equipment requiring certain nozzle types and propane bottles requiring a completely different fitting type. Admittedly, not my problem, as I was buried in the Pic ‘N Pay grocery, picking out pre-requested food items for my teammates. When I arrived at the check-out register, after the clerk had totaled all my items, a modern-day record she would later admit, she called for my ‘good friend’ Andre, who I’d been corresponding with over e-mail and had promised me that great deal which ultimately amounted to 1% back (\$75), if I signed up for their Pic ‘N Pay credit card on the spot. **Seriously, that’s the best you got?**
- Thur (3/10)** Finally our departure day arrives! We spent the morning picking our bunks/bunk mates on ship and then unpacking our gear, separating our gear into “need for the boat” and “need for the Island” piles. Then, in the early afternoon, the press, family and friends arrive and we tell our last stories, take our last photos, say our last good-byes and then prepare to depart. Our original departure time was scheduled for 1:30pm (local) and all non-South African vessels require the services of a pilot (escort) out the 100 yard channel in the harbor. So, where was our pilot? 1:30 turned into 2:00, turned into 2:30, faded into 4:30 ... Finally at 5:00, our pilot comes screaming into the harbor in a huge over-sized tricked-out tug boat. The pilot jumps on board, inspects a few things and we finally cast off and do one big donut (O) in the harbor. He departs the boat, providing little value other than a 4 hour delay and, at last, we are finally departing Cape Town at 5:30pm. **Thanks, thanks a lot, that was helpful!**
- Fri (3/11)** We barely get 10 miles south of Cape Town and are then greeted by the Southern Ocean in all her glory, as larger than anticipated waves crash against the boat, slowing us down to 7.5 knots. The Southern Ocean is best known for the Roaring 40’s Latitudes and Ferocious 50’s Latitudes, where seas can be treacherous. However, I am surprised at how the seas are surprisingly this rough early on, coming out of Cape Town, which is 38-degrees South Latitude. It was like these seas were waiting for us ... Although I don’t get sea sick, I spend 24 hours straight in bed, absolutely horizontal where I am most comfortable. I didn’t eat ANYTHING for 36 hours, as I fight through some mild sea sickness. **Thrilling 30s Latitudes.**
- Sat (3/12)** Return to more normalcy, as the seas go from very rough to not so rough throughout the day. Some of my appetite returns and I find time to begin answering student’s questions and kicking off this journal. New Zealand curried lamb is served at dinner and I commit the absolute cardinal sin of asking for a second helping. Food was delicious, but that second helping put me / my body into a mild sea-sick tailspin.
- Sun (3/13)** In the middle of the night, the wind blows in excess of 70mph I am told, big waves ensue and the boat thrashed about. No one sleeps a wink. Interestingly, the normally rough seas flatten out, but progress is very very slow into these winds. With that double shot of lamb curry, I again spend the day horizontal in bed with a mild case of sea sickness. **No eat, no sleep ... no move.**
- Mon (3/14)** Similar to Sunday eve, the wind again blows in excess of 70mph, sounding like 1000 vacuum cleaners firing off, the ocean again flattens out, if only for a moment and our progress is very slow against this force. When the wind softens we take time out to deploy our first buoy, which will take ocean salinity and temperature readings from the surface down to 6000’ for the next five years, periodically surfacing to

phone home, transmitting this data back to Woodshole Oceanographic Institute in Massachusetts. **One small step for mankind!**

- Tues (3/15)** – A somewhat uneventful day, we approach our halfway point in our journey to Heard Island. We deploy a second buoy at night and, to celebrate, we all have steaks for dinner which were delicious. However, I visit the toilet four times during the night. Perhaps you heard the fireworks? **BOOM-BOOM-BOOM-BOOM**
- Wed (3/16)** Shower day! Near the stern of the boat, Braveheart has what looks like a big windowed ‘play-pen’ and this is where we typically take our showers. The area is open to the elements and when big seas are rolling, you have the opportunity to both watch the big waves move past (outside) and then have them wash up – through the scupper – across your toes, ankles and shins (for those really big waves). We have been at sea for one week now and I’ve taken THREE SHOWERS.
- Thur (3/17)** Today is another buoy deployment day, as we launch the first of NOAA’s drifters. Unlike the previous Woods Hole depth divers, these are floaters attached to a sturdy canvas drogue, which enables the buoy to only be impacted by current and not winds. It was also a special day today as the seas were fairly calm (5-10’), so we were allowed some extended time OUTSIDE for the first time since our departure one week ago. Admittedly, I am shocked at the clear deep cobalt blue of the ocean here. In addition, we see our first wildlife, as a group of Spinner Dolphins come out of nowhere and follow our ship for about five miles. We also see a few Storm Petrels (birds), indigenous to the Southern Ocean and I’m amazed to see these birds flying out here in the middle of nowhere? These poor guys are no bigger than a swallow, yet happily find themselves hundreds of miles from any land. **Freebird!**
- Fri (3/18)** We deploy another buoy today, calling it the “Pallin Drifter,” in advance of an onrushing storm, which had formed south of Cape Town and had been chasing us for a few days. In advance of the storm, the seas start to grow to 20’. Thankfully I find a flat spot and enough time for a shower. I am one of the few. During dinner, the group comes up with the following tee-shirt opportunities: Heard Island Correctional Institute and ‘it is better to transmit, than to receive ...’. **Jeez, we need to get off this boat fast!**
- Sat (3/19)** The storm, or a fragment thereof, catches us 4-5am (local) Saturday morning, with winds approaching 50 mph, as seas reach approximately 30’. Thankfully, the storm comes and goes in a matter of hours. By 8am, the sea has flattened out, giving us a great opportunity to make better time because we are running late. Really late (to the island).
- Sun (3/20)** The storm returns in full force, again bringing winds in excess of 50 mph and the seas reach 30’. This time we are not as fortunate, as the boat rocks, rolls and pitches all night long. No one sleeps a wink, as the ride borders on terrifying all night long. By mid-day, the weather softens and yes, I find time for another shower. **Mr. Clean!**
- Mon (3/21)** Receive word we are now < 300 miles to Heard Island with an estimated 29 hours to go. The boat continues to plod along in the 10’ seas at 9-10-11 mph. At this point, I’m wondering if I could have walked faster from Cape Town to Heard Island, as we now one day late, which will compress our time and activities on Heard Island. I finally crack open the GoPro arsenal, in an effort to figure out the camera and all its accessories. Quite an impressive collection of gear, for a company who’s stock is in the pooper. Gavin helps quickly sort through all the GoPro gear, strongly recommending the iPhone application in lieu of everything else.
- Tues (3/22)** Today we learn we are only 50 miles from Heard Island, after negotiating through another rough evening of 40 mph winds and 30’ seas. Again, few sleep, as the boat bounces around like a rubber-ducky on a bathtub’s surface. However, we are now five hours away from actually seeing the Island, so despite the weariness, spirits are high! I took another shower and as the day comes to a close, here’s your unofficial SHOWER LEADERBOARD:

Who	Shower Count So Far
Big Jimii	6x
Dave(K3EL)	3x
Carlos, Vadym	2x
Bill, Hans-Peter	1x
Arliss, Bob, Adam, Alan, Dave, Fred, Gavin, Ken,	0x

- Wed (3/23)** After 12+ days navigating the Southern Ocean, Heard Island is finally spotted at about 3pm (local time). As if to symbolize, the Island is wrapped in grey clouds, it is biting cold and the wind is howling. As we get closer to the Island, we begin to notice its hard features, obviously chiseled by harsh winds. As we approach the Island, the winds continue to climb and shift to southerly (over Antarctica) bringing the temperature down to freezing and so it starts to snow. We anchor in a deep cove, off the Island, and spend our first night within earshot of our campsite on a boat covered in a lite dusting of snow. **So close, yet so far.**
- Thu (3/24)** At 6:00am (local), our first group lands on Heard and begins searching for an appropriate campsite. By

7:00am, we have identified two sites and begin initial preparations, by pounding in a bunch of small flags marking the perimeter. Being, the 'landing mule,' I come with the second group to the Island and begin pounding large tent support stakes into the first site in advance of the tent being erected. As we are planted in a lava field (a.k.a., big rock garden), it is a slow go. By 8:00am we abandon the first site and focus on the second site – in yet another reach of lava field. I pound stakes and haul 50# bags of sand (to weigh down the tent) ... The tents eventually come and we inflate them. Gear then comes across at sunset and we scramble in the remaining light to unpack our gear, get dinner and go to bed. The heater does not come with us, so we spent the night in the tent – sans heater. I climb into my sleeping bag wearing long johns, sweat shirt, ski hat, neck gator and my down jacket, shivering my way to sleep. Coldest I've ever been period. **Chilled to the bone!**

- Fri (3/25)** Team begins organizing the equipment on Island and building the radio antennas. At the end of day we have the 30m 4SQ and the 40m 4SQ live and begin operating on a limited basis. I pull the 30m 4am – 11am shift (go figure no one wants to operate) and have the great fortune of discovering an unusual path to the west coast and really enjoy working a lot of the Bay Area radio operators. Heater fails to arrive and again, it is another cold night.
- Sat Sun (3/26/27)** Heater finally arrives and it works sporadically at best. We put up the remaining antennas, 80m vertical, 2x 2L 20-15-10 yagis and 2x 2L 17-12 yagis. Strangely, many of the F12 yagi parts are missing, so I have to improvise, using duct tape and driftwood as insulators and braces, much to the dismay of my assembling partners (Arliss & Carlos). We also put up the 160m 72' high vertical after the third attempt. I will not detail (too much), how frightening it was to put up that beast during the first two attempts, in howling winds, with the vertical and guys bending in every direction due to the force of the wind. After antennas go up, the team focuses on making ham radio contacts and planning our various science projects. **Terrifying antenna work party!**
- Mon (3/28)** I draw the 3am – 7am (local) and 3pm – 7pm shifts to operate for the remainder of our stay. During the first 3am shift, the wind guts to an estimated 40mph and ruthlessly rattles our tents. It is cold in the tent, even with the heater operating sporadically and I start to wonder (if only for a moment) 'exactly what am I doing here?' **Graveyard shift!**
- Tues (3/29)** Teammate Gavin Marshall (from New Zealand) and I finally go exploring, climbing a large bluff and we discover a huge split colony of Gentoo and Marcaroni Penguins. We find this interesting because the birds are different, yet have complimentary personalities and they have somehow found a way to live together in close quarters. Maybe I should take this as a life lesson? Later in the day, as Gavin and I return home, Antarctica finally opens up to roar, driving 60-70mph winds across the island. Ever walk in 60-70mph winds? It is difficult to say the least. You have to lean way forward, take small steps and time your steps with the gusts. Step to fast, you stumble and fall down, step to slow and you get pushed aside. These high winds continue into the night, shaking the tents with great force, giving no one a chance to sleep a wink. **Walk this way ...**
- Wed (3/30)** We wake up exhausted and spend most of the day within arm's reach of tent. I help put up another two radio antennas. We now have almost as many antenna's (9) as pure radio operators (10). It is very cold outside, but thankfully the wind goes from about 20mph to nothing. The clouds clear at sunset and we have a beautiful view of Big Ben (the 9,000' volcano) and nighttime stars. Did I mention zero wind? For the first time since we landed on the island, the tents remain ghostly silent throughout the night and everyone gets a full night's sleep. This is the first time I've slept six hours straight since we left Cape Town. **At last sweet dreams.**
- Thu (3/31)** Antarctica is a place of extremes, as today (sans wind), we awake to a mix of torrential rain and freezing rain. Thankfully, the weather (direction) has rotated around to the north, rather than the south (Antarctica), which would have likely made things much cooler and fiercer. Because of all the rain, everyone clusters in the tent for warmth. Getting wet = death in Antarctica, because there's no warmth, so it is difficult for things to dry and you start to wear stuff wet and that's problematic ... We spend the day doing mostly radio.
- Fri (4/1)** After Thursday's torrential rains, some of us discover that our extreme-weather Antarctic tent has been leaking, as the water soaks many of our bunks. Vadym and I are victims (remember wet = death). We try to dry our bunkbed and then decide just to *hot-bunk* it. After gusting to 60mph during the night, the wind softens today, giving the tent a break. Admittedly, I'm starting to have concerns whether this tent can survive our trip as it has taken a beating from the wind and I'm not sure how well it is ticking (anymore). **Red Flag #1.**
- Sat (4/2)** Get the call early in the morning Braveheart crew is coming to take four lucky souls back to the boat for a hot shower. I volunteer and go to the front of the line. Interestingly, en-route to Braveheart, we see a series of mini-water spouts spin up, making the simple 10 minute boat ride from shore to Braveheart suddenly very treacherous. Seriously, I guess nothing comes easy on Heard! I take a long hot shower and recall this is easily the warmest I've felt since leaving Cape Town. Admittedly, it is nice to feel my toes

again.

- Sun (4/3) to Tues (4/5)** Just about the time the radio team starts to get into a routine, a huge aurora hits above Antarctica, crushing radio propagation and it takes almost 72 hours to recover. The day after the aurora, we have an opportunity to see the lingering aurora effects above Big Ben (the volcano) at night. It is quite a site! Storms continue to roll in pounding the tent with high winds, rain and the kitchen sink. Admittedly, some nights, I'm in complete astonishment, wondering how the tent stays up. On one particular night, the tent thrashes around so hard, the valve on the air-beam actually opens up, creating a slow leak in the air-beam for most of the night. When we do have sunlight, all the holes in the roof, created by high winds and flying debris, are starting to look like Swiss Cheese. With these holes, we are now one with the environment, if it's wet, we are wet, if it's windy, we feel the breeze which is not good. **The routine!**
- Wed (4/6)** During the day, "cabin fever" strikes bad and Arliss and I decide to hike to the top of Mount Drygalski, a small ridge of approximately 600m elevation about 3 miles from our camp. We hustle to the top in just over an hour working up a good sweat in the process. We cross over an eroding lava field and ancient scree, which is slowly eroding after. This is our first exercise in quite some time and we are gassed. The view at the top is spectacular and stinky, as there is apparently a large Gentoo Penguin rookery on the other side of the mountain and the guano smell is piercing ... Arliss is the team doctor by day, a struggling comedian by night and an good-guy. Later that night, with the help of our satellite connection and Skype, I "link the remote real-time" as I present life on Heard Island to Mia's 7th grade class at Del Mar. **Cabin fever**
- Thu (4/7)** We have another day of heavy rains and fierce winds. The team decides to set a team goal of making 82,000k contacts before we depart, hoping to top the previous radio team's total on Heard Island in 1997. So it becomes all hands on deck for the next four days as we try to connect with as many radio operators as possible during this period. Later that night, with the help of our satellite connection and Skype, I again "link the remote real-time" and present life on Heard Island to Jake's 3rd grade class at Bel Aire. Marjan Sobhani is geeked up and she has her students really amped up when I call in. Their energy is both contagious and warming. A great experience is had by all. **All Hands On Deck!**
- Fri (4/8)** Normally rains come in the early morning and then dissipate by breakfast. Unfortunately today's torrential rain continues non-stop throughout the day, ruining Gavin and my opportunity to go on walkabout. We had planned to climb Mount Drygalski, visit the Gentoo Penguin rookery on the back side and then take a series of soil sample (in search of new life forms). Unfortunately, with rain and the cold restricting movement, it is back to the radio full-bore and it is starting to get old. While I'm radioing the rains dampen my sleeping bag which could be problematic.
- Sat (4/9)** Torrential rains arrive in the morning again and evolve into freezing rain later in the day. Gavin and Fred are not deterred and we decide to go on walkabout to collect soil, rock and water samples at various points around the island. We start by climbing up the flank to Mount Drygalski, where in a downpour of freezing rain, Fred collects a series of interesting (to him) rocks. As we continue up Mount Drygalski, the winds pipe up to 40mph and the freezing rain continues to bombard us. We climb up and over another flank of Mount Drygalski to arrive at the edge of Schmidt Glacier where we stop and explore. While at Schmidt Glacier, we collect water, soil and rock samples, alongside the glacier, as there has been considerable retreat here. Here the glacier has separated from the earth and it affords us an opportunity to climb between glacier and earth and collect more rock, soil and water samples. With the glacial retreat in this area, we are hoping this virgin environment/soil will provide us a great opportunity to discover new (micro) life forms. **Virgin soil and a search for new (micro) life!**
- Sun (4/10)** Torrential morning rains return again, alternating between rain, freezing rain and pea-sized hail on this day. The sleeping tent continues to leak and most of Vadym and my gear range from moist to wet. Unfortunately, the 2nd tent heater goes "tits up" on this day and without any heat, the tents get extremely cold forcing everyone to gear up. We also receive word from the Braveheart, who's experiencing 24' swells at the anchorage in the cove, there's extreme weather brewing, which will force us to leave the island a day early. So we sadly begin to dismantle some of the radio stations and pack up our extraneous gear. Radioing continues on, in an abbreviated state and we ultimately conclude with just north of 75,000 contacts. Not bad considering all we had to fight through, but short of our stated goals. **Last dance with Heard Island**
- Mon (4/11)** We awake to approximately 2" of snow on the ground, with some hostile clouds, signaling more bad weather to come. At approximately 7am (local), Arliss, Carlos and I begin dropping and packing the remaining yagis. The weather alternates from freezing rain, hail and snow throughout the morning, while the wind continues to blow that all too familiar 30-40 mph. Next we clear out all the gear in the sleeping tent and by 11:30am we pull up the tent's floor boards and begin the deflating process. We stop for lunch and then begin clearing out the ops tent and the deflating process begins by 1:30pm. By 3:00pm (local) all the gear has been removed from the campsite and the team makes our slow walk to the point to be ultimately picked up and taken to Braveheart. Everyone is safely loaded onto Braveheart by 5:00 and we take our last look at Heard Island and Big Ben as dusk arrives and (fittingly) it starts to snow. We

officially weigh anchor and depart Heard Island at around 9pm – I’m already fast asleep, exhausted from the days’ events. **Heard bids us goodbye!**

- Tue, Wed, Thu (4/121314)** We return to the Roaring 40’s, as Braveheart navigates through the Southern Ocean (again) en-route to Perth. Throughout the day we face typical waves of 15-25’ and winds of 30-40 mph. The ride is extremely rough and everyone struggles to regain their ‘sea-legs.’ No one sleeps much, spending most of their time horizontal in/around their bunks. Outside of Gavin, no one eats very much. However, thanks to a great tailwind and the Antarctic Convergence (current) push, Braveheart has been roaring at a top speed of 13mph. At this rate, we could get to Perth a couple of days early ... Should I start planning? **All ahead full** ...
- Fri (4/15)** We are approaching halfway from Heard Island to Perth and it is reason to celebrate, so I take a shower and put on a short-sleeve tee-shirt and my regular Levis for the first time in a long while. I had previously been wearing my fleece-lined Levis and surprise – sans energy drinks, sweets and booze over the course of this trip, my waist has shrunk three belt holes in my original levis. Seas flatten out a bit and we continue to steam towards Perth, but not wanting to be too far ahead of schedule, we slow down to our regular dogged pace of 8-10 mph. **Fatty daddy no mas!**
- Sat (4/16)** We are officially halfway and everyone is quite excited, as it is (apparently) all downhill now. Seas continue to flatten out and we limp along at 8-10 mph, despite the Antarctic Convergence (push). At night, we celebrate with Gin + Tonics and ice chiseled from our glacial samples. We drink a lot which helps force us into bed early because the night is a rough one, as a large storm that’s chasing us swings around through the night and hit’s us head-on at 3am (local). This brings 25-30’ high waves and 40 mph winds. I know this because it is the first time I am literally lifted out of my bunk, as the boat rises up to catch a big wave, then dips deep into the wave’s trough, leaving me suspended in the air for a second then (the boat) comes back up and my bunk smacks me. Because I was sleeping in the starboard bow, I’m battered like this for over four hours. No sleep for me, as I arise battered and bruised. **Daddy ping pong.**
- Sun (4/17)** Things return to normal, as everyone sleeps late because of the storm and, of course, Gin + Tonics. The Southern Ocean plays nice during the day, so everyone who needs, finds time to take a shower. We are now approximately 1,000 miles southwest of Perth and continue to plod along.
- Mon (4/18)** Everyone sleeps in again, as today the Southern Ocean goes especially calm (for the Southern Ocean) presenting a sea-state of approximately 5’. Thankfully, we finally have moved out of the Roaring 40s (Latitudes) and now into the Thrilling 30s (my moniker). Interestingly, the water temperature is 18 C, which is far cry from Heard Island’s 2 C. At approximately 650 miles southwest of Perth, we spot our first ocean-going vessel (a fishing boat), since the day we left Cape Town. I spend most of the day building my final class presentations for Ms. Lowry and Ms. Sobhani’s crew.
-

Things we learned

Environmental:

- Many of Heard Island’s hard angular landscapes have been chiseled by the constant gale-force winds, making the island seem very ominous
- In our 20 days on Island, we had one day of sunshine (temp = 40 F), the others were different shades of cold with winds blowing 30-70+ mph
- Without sun, nothing ever gets dry on Heard Island ... ever
- Approximately 80% of Heard Island’s beaches are clean of trash, while the other 20% are a disaster
- Interestingly, some glaciers (inland) are receding, while others (at water’s edge) are not
- Where those glaciers are receding, exposing soil for the first time, we took many glacial water, soil and rock samples (to be analyzed) with the hope of identifying new (micro) life forms. Stay tuned!

Animal:

- For it being “off” season, there sure were a lot of penguins still remaining on island (didn’t they get the memo?)
 - King Penguins are wonderful companions, with endless curiosity
 - Rock Hopper + Macaroni Penguins (pictured) often live together
 - Skuas are hungry, flying rats, who have no fear
 - Generally speaking fur seal pups are more aggressive than their parents
 - All fur seals/elephant seals sleep a ton and often burp and fart intermittently while sleeping , which offers great background music on the island.
-

11. EVIDENCE OF RECENT CHANGE

A central theme in the scientific investigation by this group was to seek evidence of significant local geomorphological, biological, and other changes and their causes, *e.g.*, climate change and volcanism. In this regard, we reproduce a section of the Project Plan (v6.3 8 Oct. 2015 p.14, footnotes omitted):

It is sensible ask the question: “What is the relationship between the climate on Heard Island and the diversity (=species richness) there?” There is, of course, considerable literature concerning this question. For instance, Chambers, in a review mostly concerning Australia, stated:

Recently there has been a resurgence of interest in the use of natural systems as indicators of climate change, with evidence mounting that the anomalously high temperatures seen in the twentieth century have already been associated with changes in many physical and biological systems around the globe, ...

Among additional examples, she cites observations for Heard Island and the Australian sub-Antarctic:

Component	Natural system change	Reference
Glaciers, snow cover/melt	Glacial retreat; approx. 35 km ² of new terrain exposed between 1947 and 2000	Bergstrom, 2003
Mammals	Population increase in fur seals <i>Arctocephalous gazella</i>	Budd ,2000
Birds	Population increases in black-browed albatross <i>Diomedea melanophris</i> and king penguin <i>Aptenodytes patagonicus</i>	Chambers et al., 2005
Invertebrates	[No information]	
Vegetation	Changes in plant communities, <i>e.g.</i> , native creeping herb outcompeting and overgrowing the dominant plant species, a cushion plant	Bergstrom, 2003

The environmental change on Heard Island is described by Thost and Allison:

There is now considerable evidence that the climate on Heard Island is changing, resulting in significant glacier retreat, formation of lagoons and freshwater lakes, and colonization of newly exposed land by plants and animals. ... These changes are a reflection of large-scale changes that have been identified elsewhere in the Southern Ocean.

Chambers goes on the say that, because there have been very few studies of climate effects,

... for many of the categories, particularly for invertebrates, amphibians, and reptiles, it is clear that we have very little idea of how changes in climate are affecting these species and systems on local, regional, or national scales.

From these and many other sources, it is clear that: (1) the climate change experienced on Heard Island is driven by global change; (2) the change is large; (3) the effects of the change on the ecosystem are major; and (4) the diversity is inadequately documented and poorly understood. This set of connections, together with the alien-free ecosystem of Heard Island, provide a strong incentive for the expedition, to complete the record of the island’s biodiversity and link it with global climate change.

We will next summarize some observations made during the 2016 visit that bear on these issues.

Growth of Mawson Peak

In 1997, the author observed smoke and steam coming from a vent on the right-hand (westerly) shoulder of Big Ben, as seen from the ANARE ruins. However, no actual vent structure was visible above the slope. In 2016 the team documented a large edifice, also emitting steam and smoke. The edifice shows a flat, apparently open, crater about 25m in diameter. Careful measurements of the elevation of the crater rim show that it appears about 45m above the visible slope. If the slope is currently at about the same altitude it was in 1997, the edifice must have grown at least 45m in 19 years, an average rate of 2.4m/yr. The standard elevation given for Mawson Peak (the value widely quoted in the literature), is 2745m. Therefore the edifice must have a current elevation of (at least) 2790m.



Figure 658 – The vent edifice photographed 23 March 2016 from Atlas Cove •



Figure 659 – In 1997 only emissions were visible



Figure 660 – By 2016 the edifice had grown 200m above the slope

Glacial erosion – ice slumping

The following images are taken from satellite images of a remarkable feature we call the “blue gash.”



Figure 661 – The “blue gash” 2009



Figure 662 – The “blue gash” 2014

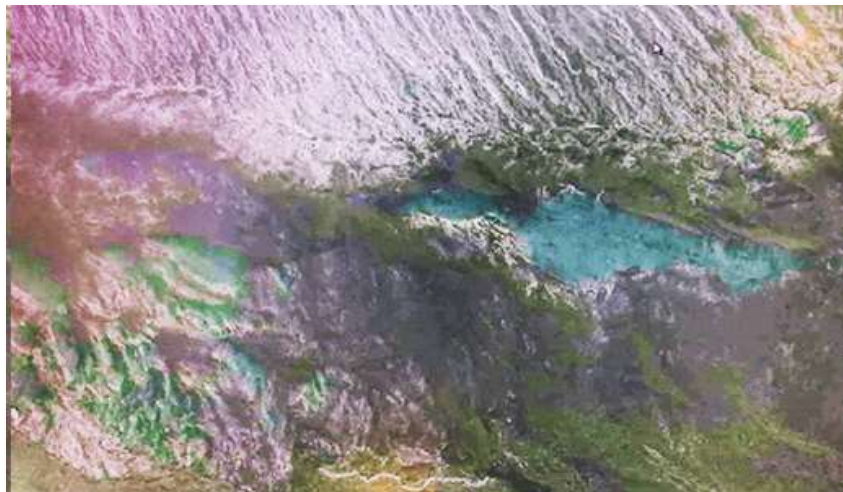


Figure 663 – The “blue gash” 2015

The images above show large-scale removal of a relatively thin overlay of reddish soil (gravel). Clearly these are sediment-covered glaciers that are being actively eroded. The gash is glacial ice exposed by the slide of sediments from the upper edge of the plateau, down the gash, depositing them at the foot of the slope. The lower image above suggests that to a great extent, the gravel overlayer falls in chunks, rather than stone by stone. The deposits are called colluvium.

The mechanism of this erosion is illustrated below. Starting with a smooth slope, a short (ca 50-100 ft.) section of the overlying sediments is removed by a sudden slump, and slides down the ice face to pile up at the top of the colluvium deposit. Numerous images of these structures suggest that the ice is removed by melting, precipitation, or evaporation, leaving an overhang that is detached by its own weight. The net result of repeated slumps is that the gash moves upslope, as seen in the sequential satellite images above. The average rate of advance of the gash is about 10 ft./yr., or about 1 ft./month, although it is highly likely that it is sporadic, not continuous.

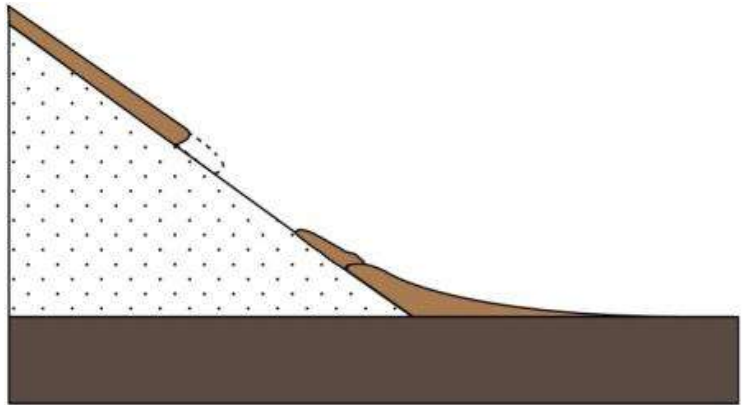


Figure 664 – The mechanism of lateral moraine slumping, which generates an exposed ice wall that moves upward in time

These glacial slope slumps are currently extremely common on Heard Island: Below (left) is a satellite image of the terminus of Fiftyone Glacier with the areas of exposed (blue) ice enhanced. Literally hundreds of such exposures can be easily identified in the Heard Island glaciers.

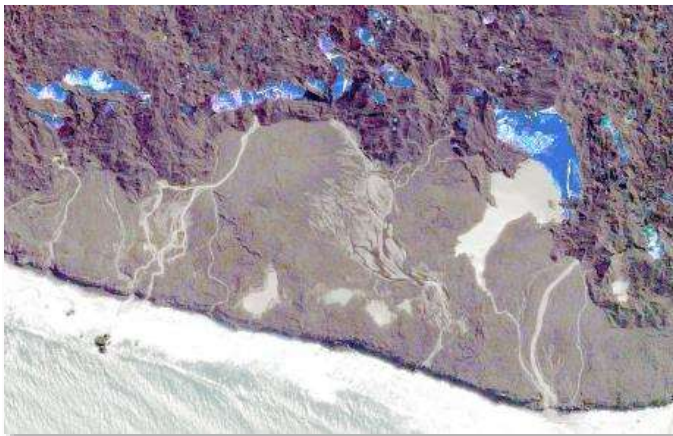


Figure 665 –Satellite image of glacial slope slumps at the terminus of the Fiftyone Glacier



Figure 666 – Photograph of a glacial slope slump

The image above (right) is of an exposure on the Black Rapids Glacier in the Alaska Range. This picture, by Wickersham’s Conscience [<https://wickershamsconscience.wordpress.com/2011/06/10/the-galloping-glacier/>], is startlingly similar to the Heard Island images.

We make a distinction between this ice-slope overlayer slumping and lateral moraine slumping. The latter is strictly a slumping of a sediment moraine, while the slumping described above is across an ice face.

Another case of glacial slumping is shown below. The satellite images from 2007 and 2014 show a slump that occurred in the past 10 years. The enhanced 2014 image (middle) shows the exposed ice wall above the slump and the stream that flows from the bottom of the slump. The 2016 team documented this slump (bottom).

Breakwater degradation

The Stephenson Lagoon filled a steep valley (at least 100m deep). At the start of this process, there were two much smaller lagoons, one at the south side and one on the north (northeast). As the glacier melted, these lagoons enlarged and eventually joined. The breakwaters that had formerly isolated the lagoon(s) from the sea came under attack, and began to disintegrate. It is regrettable that the opportunity to monitor the intrusion of seawater into the growing freshwater lagoon apparently was missed.



Figure 667 – North breakwater 2006 Satellite image



Figure 668 – South breakwater 2006 Satellite image



Figure 669 – North breakwater 2007 Satellite image



Figure 670 – South breakwater 2014 Satellite image



Figure 671 - North breakwater 5 April 2016



Figure 672 - South breakwater 5 April 2016

Land erosion – Red Island isthmus

At the northern tip of Laurens Peninsula is a narrow isthmus connecting to a large volcanic edifice about 40m high. Since 1874, the rock has been referred to as "Red Island," there is no evidence that it was ever actually an island. The 2006 satellite image (Google Earth) shows that at that time the isthmus was at most 3 m high, hence could easily have been breached by storm-driven surf. Quite a different situation was observed during the 2016 expedition: the isthmus is cut through with a broad flood channel, part of which is the old lagoon.



Figure 674 – Red Island and the isthmus, view from near Magnet Point March 2016 ●

Near the northeast limit of the flood channel is a narrow channel (right) that is probably an erosional avulsion. The width of the channel is currently about 5m, but this is certain to increase as storm-driven surf, especially on the east side (Sydney Cove) drives water through it. Clearly, the isthmus has been permanently breached, converting “Red Island” into an actual island. In fact, we would expect the entire low-lying isthmus to disappear within a decade or so.



Figure 673 –The channel (avulsion) in the isthmus

The 2006 satellite images (below) of the isthmus shows it is continuous, with a lagoon.



Figure 675 – Red Island isthums 2014



Figure 676 – Red Island isthmus 2016

Glacial retreat – Lagoon formation

Probably the most spectacular change over the past 10 years is the ongoing rapid retreat of the Stephenson Glacier and the filling of the glacial trough to form the Stephenson Lagoon. In previous parts of this document we have shown numerous pictures of this lagoon. Here we show satellite images and maps from 2007 and 2014. The complete loss of the glacier in less than a decade might generate regrets that there has been essentially no significant scientific investigation of this remarkable event.



Figure 677 – Spit area 2007

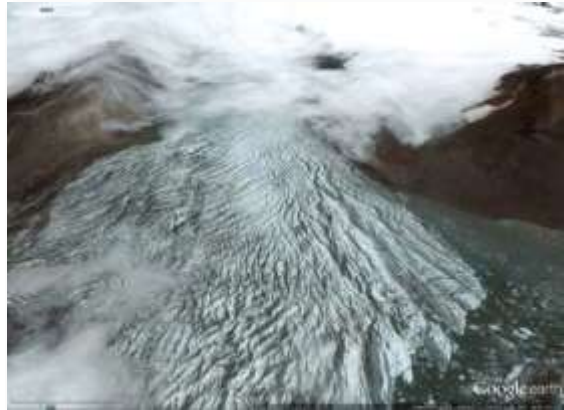


Figure 678 – Stephenson Glacier 2007



Figure 679 – Spit area 2014



Figure 680 – Stephenson Glacier 2014

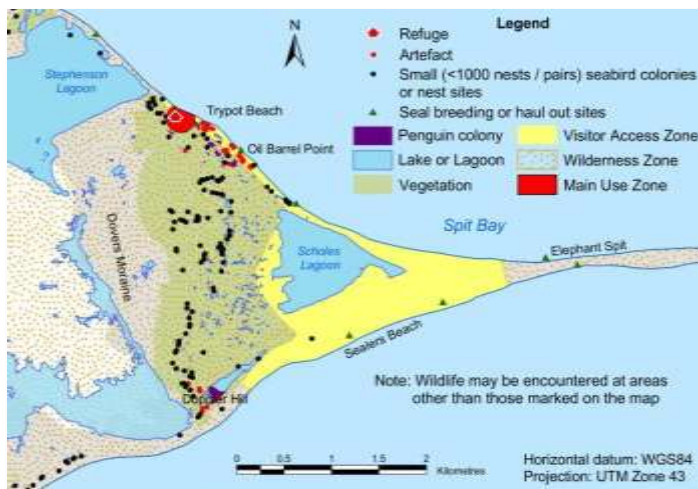


Figure 681 – Map of Spit area circa 2000

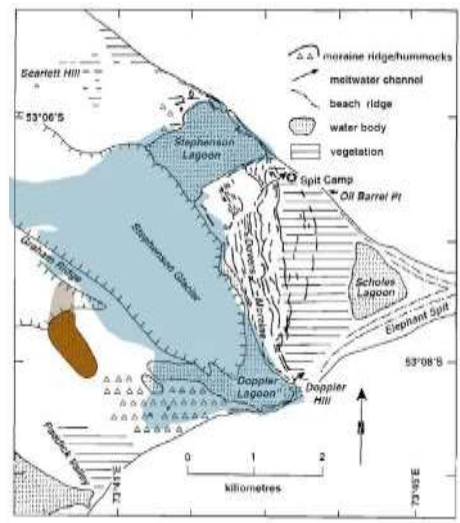


Figure 682 – Map of Spit area circa 2014

Lagoon disappearance, subsurface streams

Although not part of the actual field work of the 2016 expedition, we spent considerable time studying satellite images of Heard Island obtained from Google Earth. Most of these images had to be enhanced for brightness, contrast, dehazing, *etc.* For much of the island, images are available for 2006, 2007, 2009, and 2014, providing the opportunity to identify significant changes. Here we show three images of the foot of Fiftyone Glacier, located between Lavett Bluff and Lambeth Bluff, on the southernmost coast of the island. These images are all the same scale and show the same region. It is evident that the lagoons disappeared around 2010, leaving a network of streams issuing from the glacier terminus.



Figure 683 – Fiftyone Glacier 2006



Figure 684 - Fiftyone Glacier 2009



Figure 685 - Fiftyone Glacier 2014

Historical photos

We have accumulated a collection of historical photographs. Because they speak to the change (or lack thereof), we include here a small number of such pictures.

Hugh Milburn (1969)



Figure 686 – Big Ben (Hugh Milburn, 1969)



Figure 687 – Azorella Peninsula (Hugh Milburn 1969)

Cordell Expeditions 1997



Figure 688 – Big Ben (January, 1997, Cordell Expeditions)



Figure 689 – VKØIR (January, 1997, Cordell Expedition)

Francis Lynch (1999)



Figure 690 – East side Big Ben (Francis Lynch 1999, <http://www.travel-images.com/heard-mcdonald.html>)



Figure 691 – East side Big Ben (Francis Lynch 1999)

Grahame Budd 2012



Figure 692 – Big Ben (Grahame Budd 2012)



Figure 693 – Laurens Peninsula (Grahame Budd 2012)

12. SUMMARY OF RESULTS

Accomplishments

The 2016 expedition was not only multi-disciplinary (field science, infotech, amateur radio)—it was also multi-activity, in the sense that there were multiple individual projects within each of these disciplines Here we list these projects and indicate their general activity and results.

FIELD OPERATIONS

Buoy deployment	Drifter buoys (NOAA) and 5 diving buoys (WHOI) deployed on specified latitudes during voyage. Real-time monitoring of they signals. Still functioning 6 months later. [Adam Brown]
Seabirds	Logging and reporting seabirds during latter portion of the outbound cruise. [Bill Mitchell]
Atlas Cove	Multiple day trips to explore and photo-document geology, animals, plants, and debris of Atlas Cove area, including ANARE, Nullarbor, Mt. Drygalski, Corinthian Bay. [Gavin Marshall, Fred Belton, Robert Schmieder, team]
Laurens Peninsula	Four days of exploration of the northern portions of the Peninsula and Mt. Dixon, including photo-documentation, and collection of rock samples for Jodi Fox. [Fred Belton, Gavin Marshall]
Stevenson Lagoon	First entry by small boat into the Stephenson Lagoon. Extensive photo-documentation of the surrounding glaciers, beach, north and south breakwaters. Emphasis on changes that occurred since the 2014 satellite imaging. First sediment and water specimens. Bottom sample and depth measurement of the lagoon. [Robert Schmieder, Fred Belton, Gavin Marshall]
Specimen collections	About 40 documented specimens of rocks, soil/sediment, water, invertebrate, debris from the Nullarbor and Laurens Peninsula. Rock specimens transferred to the University of Tasmania, others to Cordell Expeditions. [Fred Belton, Gavin Marshall, Robert Schmieder]
Drone flight	First flights of a drone on Heard Island. Aerial video of the campsite. [Gavin Marshall]
Ultra-high resolution photos	Ultrahigh resolution images using the GigaPan scanning camera mount. [Bill Mitchell]
Weather	Record of the weather with an automatic station. [Robert Schmieder]
Temperature/illumination	Record of the temperature and illumination with recording probes. [Robert Schmieder, Steve Smith]
Clouds	Records of clouds and interpretation for classroom. [Jim Colletto]
Dolphin death	Observation of multiple dolphin skulls in restricted area
Debris	Documentation of geologic, inorganic, organic, bonal debris. [Fred Belton, Gavin Marshall, Robert Schmieder]
AAD refuge shelters	Repair of rust-frozen doors. Stash pf emergency food left inside galley shelter. Alan Cheshire, Robert Schmieder]
AirBeam shelters	Tests of performance of shelters in extreme conditions
Candidates for naming	Identification of features worthy of separate names. [Robert Schmieder, Fred Belton]

INFOTECH OPERATIONS

Websites	www.heardisland.org , [Robert Schmieder], www.vk0ek.org [Rich Holoch]
Newsletter	Electronic Newsletter distributed to more than 7000 persons average monthly. [Bob Schmieder]
Social media	Presence on Twitter, Facebook, <i>etc.</i>) [Rich Holoch KY6R, Mike Coffey KJ4Z]
GPS trackers	Activation of trackers to provide real-time location of the vessel during the cruise/. [Adam Brown, Bill Mitchell]
Internet terminals	Four BGAN terminals provided continuous high-bandwidth connection to the internet. Extensive model calculations predicting operation of BGAN terminals. [Inmarsat, Ken Karr]
SatPhones	Multiple satphones for local and remote calls [Inmarsat, Iridium]
Internet access	Unlimited air time on Inmarsat satellites [Inmarsat Government, Ken Karr]
eMail	Unlimited access to eMail for the team and public.
Skype	Multiple interviews via Skype [Robert Schmieder, Bill Mitchell, W5KUB, Skype conferences with classrooms in Ukraine and California [Vadym Ivliev, Jim Colletto] Personal calls to selected people [Robert Schmieder, others]
Help Desk	FreshDesk implementation of a Help facility, allowing submission of any question or comment and response by the offsite VK0EK team. [Rich Holoch KY6R, Mike Coffey KJ4Z, various team members]
AudioLog	Multi-daily audio recordings of status messages by telephone. [Mike Coffey, Robert Schmieder]
QSLs	Online QSL card request (OQRS) implemented, with automatic LotW upload [Tim MØURX, Rich KY6R]
Souvenirs	Online ordering of expedition souvenirs (mug, tee-shirt) and radio souvenirs (golf shirts). [Robert Schmieder, Rich Holoch KY6R, Mike Coffey]

AMATEUR RADIO OPERATIONS

Maritime mobile radio	HF operations during about 12 days each on outbound and inbound cruises. More than 10,000 QSOs logged. 1 station, average about 400 QSOs/day. [Hans-Peter Blattler HB9BXE, Vadym Ivliev UT6UD, and others]
Activation of Heard Island	First activation for amateur radio in 19 years. Used station call VKØEK. More than 75,000 QSOs in 20 days of operation. Average 4 stations, about 1000 QSOs/day/station. [The team]
DXA	Operation of the real-time online graphic log server, allowing confirmation of QSO within 2 minutes. Recorded 70,000 unique callsigns in sign-in. Updated version 3. [Robert Schmieder, Pete Bourget W6OP]. Implemented Content Distribution Network. [Mike Coffey KJ4Z]
WSPR	Participation in Weak Signal Propagation Reporter network (WSPR) [Adam Brown]
LotW and ClubLog	Automatic upload to Log of the World (LotW) and ClubLog for DXers who requested QSL cards. [Rich Holoch KY6R]
160m operation	Special antenna, near-record number of QSOs on 160m. [Vadym Ivliev UT6UD, team]
Remote operation	Control of radio on Heard Island by operator in California. [Mike Coffey KJ4Z]
JT65 mode QSOs	Operation using the weak-signal mode [Bill Mitchell]

Activities not done

The Project Description document, and the evolving plans for the expedition, envisioned a much larger set of activities than could be carried out. In particular, in mid-2015, when we were forced to move from a large vessel with a team of 35-40 to Braveheart, which could accommodate only 14 people, as significant number of projects and the participation of many persons were simply impossible. In addition to this reorganization and reduction, certain operations were not allowed under the AAD permit.

In the following table we list and describe the principal activities that could not be carried out.

AREAS NOT VISITED

ANARE	The ruins of the ANARE station are off-limits to any visitors. In accordance with instructions from the AAD, we marked off a perimeter around the site roughly 50m from the current center. The perimeter was marked with flags and the team was instructed to not cross the boundary, and so far as we know no one did. However, we were able to obtain many good-quality photographs from outside the perimeter.
Azorella Peninsula	The AAD permit specifically prohibited entry into the Azorella Peninsula, so none of our team made any entry.
Hoseason Beach	Hoseason Beach, on Corinthian Bay, was included with the allowed entry area by the AAD Permit. However, the Baudissin Glacier blocked the passage from the Nullarbor, at least at high tide. It was felt imprudent to make the passage at low tide, considering the potential for rapid weather changes.
Glaciers	The AAD Permit allowed entry onto areas up to 1000m elevation, especially around the Stephenson Lagoon. However, the Permit also explicitly proscribed “entry onto any glacier,” a condition that was ambiguous. To be sure that the Permit was followed, no team member ascended a glacier on the slopes of Big Ben, although such exploration was part of the proposals submitted for documenting the glaciers.
Blue gash	In the satellite images, Robert Schmieder identified a “blue gash,” which was interpreted as the bare ice exposure of a glacial terminus slump. Eventually, many (perhaps hundreds) of these slumps were identified in satellite images, and during the visit to Stephenson Lagoon, both the nature and the extent of these slumps was fully understood. However, time did not permit visiting the original “blue gash.”
Brown Lagoon	The AAD Permit generously included an arm of access from the Stephenson Lagoon (north breakwater) to Brown Lagoon. It was of great interest to examine the latter because satellite images showed extensive features related to –glacial erosion and retreat, including subsurface streams. Unfortunately, during the visit to Stephenson Lagoon there was a weather opening of only about 3 hours, far too little to allow a hike to Brown Lagoon. Landing through the surf on that day was impossible.
Laurens Peninsula south	The AAD Permit allowed visit to, and collection of specimens from, the entire west side of Laurens Peninsula. In principle, access to the south portion could have been made via the extremely narrow and steep isthmus at the west edge of Walrus Beach, but the ship’s skipper decided to land the exploratory team (Gavin Marshall, Fred Belton) via Sydney Cove. During the four says on the Peninsula, the team was only able to explore the northern areas: Red Island, Magnet Point, the lower slopes of Mt. Dixon, and the area around the red apple shelter near the Cove.
Long Beach	Although it was an early target of the expedition, conversations with Eric Woehler in Tasmania in January, 2015, dissuaded us from attempting a landing there. In fact, it would have severely stressed the schedule, and would have introduced a level of danger not advisable for the available support.
Spit Bay visitor area	The AAD Permit proscribed the access modes for reaching the (five) shelters at Spit Bay. Our original interest was to have the option of setting up a radio operation from that location, in order to get around blocking by the volcano. The Permit gave us two alternatives: (1) By sea, through the surf; (2) By land, from the Wilderness area into the Visitor Zone (but no return to the Wilderness area was permitted). Both of these plans were frustrated: (1) On the day we were able to visit, the surf was violent and considered unpassable; (2) We could not have carried our equipment, including food

and water, generators, radios, antennas, and cooking and bedding facilities in one trip. Ironically, it turned out that there was actually no need for the radio operation from Spit Bay–the operation at Atlas Cove showed no significant loss of contacts due to the volcano.

Atlas Cove refuge shelters

The refuge shelters just to the east of the ANARE were erected by the AAD in 2003, and provide for emergency refuge, for instance if a group of visitors were to be trapped by weather. Although we request the use of these shelters to reduce the amount of cargo to be transported and erected on the island, the AAD Permit refused to allow such use, based on the possibility of asbestos contamination. However, the Expedition Leader was permitted to enter the galley shelter and sign the visitor log. Upon arrival, we found the two water tank shelter doors rust-frozen shut. The Expedition Leader authorized one team member, Alan Cheshire, an Australian citizen, to repair the doors, which he did by disassembling the handles and refurbishing them. Most contents of ANARE emergency food cache were well past use-by dates, although still edible if necessary. Most of the chocolate was covered in mould and deemed unfit for consumption. It was therefore disposed of. Among other observations was the fact that some of the stores of emergency food, especially chocolate, was in good condition. Entries were made in the visitor log for the 1997 expedition (which had not been done then), and for the current 2016 expedition. Upon leaving the island, the team left their entire store of emergency food (two buckets) in the galley shelter.

ACTIVITIES NOT DONE

Big Ben summiting

Among the primary original goals was to put two teams on the summit of Big Ben to search for communities of biota supported by the fumerole heat from Mawson Peak. Such communities are well-known from many other places, *e.g.*, the deep oceanic “black smokers.” Give the quasi-continuous venting at Mawson Peak, such colonies seem very likely. Unfortunately, when it was necessary to move from the Shokalskii to Braveheart, the team size had to be reduced from 34 to only 14. This obviously eliminated the climbing teams, as well as other activities that had been planned.

Drone overflights

Two members of the team (R Schmieder and Gavin Marshall) brought aerial drones in the expectation of using them to survey penguin and seal colonies, Azorella and Kerguelen cabbage, selected geomorphological features that were likely to show significant changes since the last survey (to our knowledge, never done with drones). Unfortunately the AAD Permit specifically forbade operating the drones above colonies, plants, Heritage areas, and severely restricted the altitudes. Consequently there was no opportunity to carry out the surveys we had planned, and the opportunity to obtain these observations was lost.

Marine sampling

During the planning, the expedition did not have a diving team, hence no application was made for collecting marine specimens. However, during the visit the anchor of Braveheart was recovered with small amounts of mud adhering, and it is obvious that there would be interesting meiofauna in that mud. Accordingly, a request was made to the AAD while we were still at the island to retain these samples, which comprised about 100 cc. Unfortunately the request was denied, and instead the recommendation was made to apply for a separate permit. Obviously there was no time to do that, so the marine samples were lost.

Radio operations at Spit Bay

This could not be done due to the inability to access the Visitor Area (see above).

Remote station

A plan had been generated to set up a single radio station that could be operated remotely through a satellite terminal. The idea was to provide for a continuous monitor of environmental conditions, monitor the conditions at the ANARE ruins, provide for 2-way radio contacts by radio amateurs worldwide, and to provide an emergency communications facility located in one of the refuge shelters. The AAD Permit, however, disallowed leaving any articles, materials, or substances on the island when we left, so this plan was not implemented.

13. CONFORMANCE TO THE PERMIT

This is an image of the Permit to Visit, provided by the AAD.



Figure 694 – The Visit Permit from the AAD

We have worked through the Permit as issued 1 March 2016 (copy available [here](#)), and re-read each provision. The following comments are an accurate assessment of the expedition vis-à-vis the Permit.

Section 1 Specific Activity No. 1 (COMMUNICATIONS PROJECT)

This Activity contains two major goals of the project, namely Infotech and Amateur Radio.

Section 2 Specific Activity No. 2 (FIELD RESEARCH PROJECT)

This Activity is equivalently referred to as Field Research, Field Science, and similar terms.

Section 3 Time Period

The visit was carried out 22 March 2016 to 10 April 2016, within the time period permitted.

Section 4 Authorized persons

The provisions of this section were fully met.

Section 5 Post-activity reporting

By request of Cordell Expeditions and agreement with the AAD, the Post-activity Report (this report) was delayed until 31 August 2016. However, it was found that a complete report would be significantly larger and would take significantly more preparation time than anticipated. A work-in-progress version of this report was posted on the www.heardisland website on 13 Oct. 2016, and the AAD was informed and acknowledged this posting. The present document is the anticipated Report, but it likely will undergo repeated updates. The most recent update of this Report will be posted on the website.

Section 6 General Conditions

Sections (a) – (j) were read, understood, and carefully followed. This section was taken very seriously by the team and by the crew of Braveheart. If necessary, the author will respond affirmatively to each and every point in this entire section, and will solicit corroboration from the team and local officials who were present during these processes.

Section 7 Conditions for the Communications Project

The documents referred in this section are extensive, and it is impractical to recount each and every provision to claim accordance. It can be said that the author is thoroughly familiar with all these documents (having written a large part of them!), and hence we simply assert that all operations for this Activity conformed to the documents mentioned.

Section 8 Conditions for the Field Research Project

As with the previous section, the documents referred in this section are extensive, and the author is thoroughly familiar with all these documents (having written a large part of them!). Therefore, we will again simply assert that all operations for this Activity conformed to the documents mentioned. However, this section contains many specific provisions, including access, wastes, UAV, and specimen collections. Again, we state categorically that all these provisions were satisfied in the operation, including the location. The inspector of the specimens in Fremantle confirmed their number, volumes, weights, and nature of the collection, and approved the collection.

14. RECOMMENDATIONS FOR FEATURE NAMES

At the conclusion of the expedition in Fremantle, the AAD representative invited the Expedition Leader to propose names for features that are currently unnamed. We have identified five features that are sufficiently significant to merit recommendation. These features are listed in the following table.

Feature
Islet in Sydney Cove
Isthmus connecting to Red Island
Glacier west of Stephenson Lagoon
Tarn west of Stephenson Lagoon
Island east of Stephenson Lagoon

The following map shows the locations of these features.

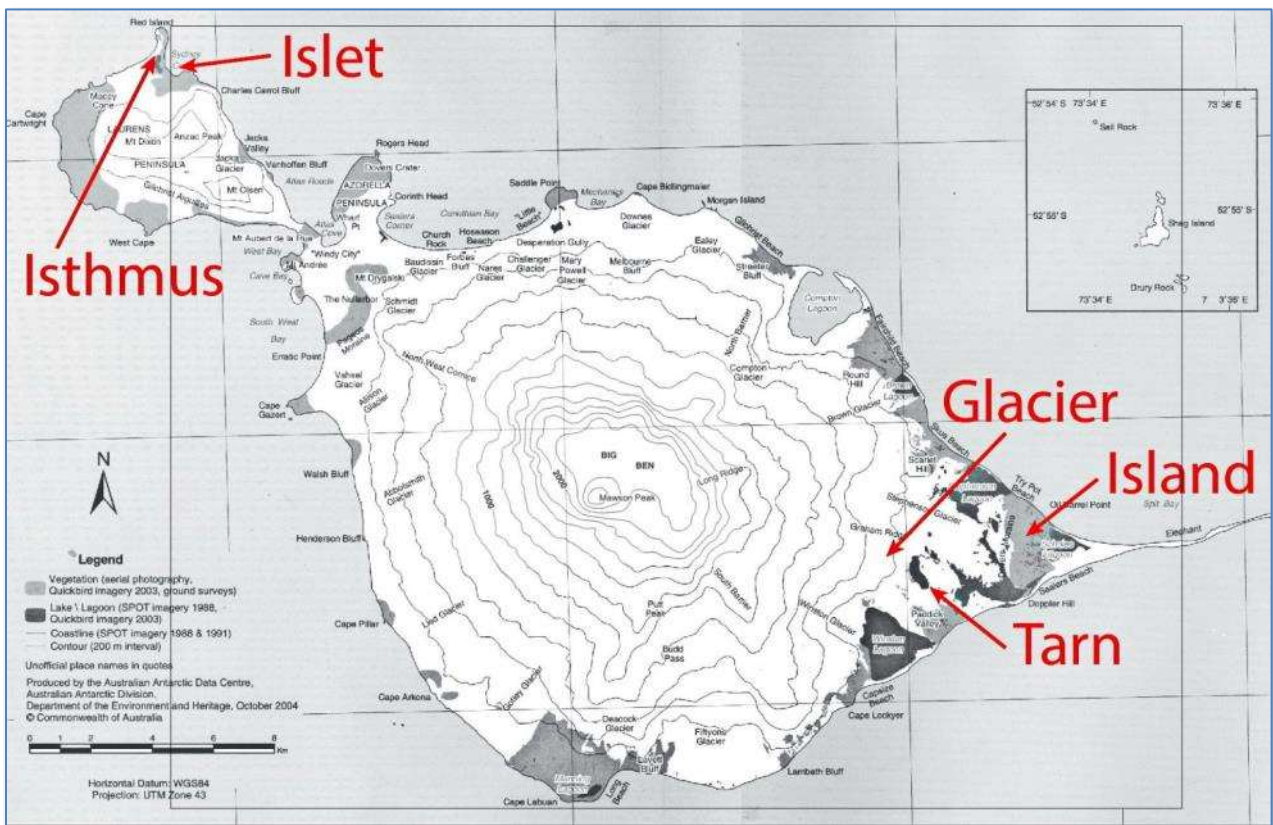


Figure 695 – The features for which a name is recommended.

In the following pages, each of these features is shown and relevant comments are provided concerning the merit of assigning a name to the feature. Our criteria for proposing that names be assigned to these features are:

- No existing name is known
- Relatively isolated and recognizable as an identifiable geomorphological structure
- Likely to have sensible permanence
- Sufficiently significant to expect that it will be a useful name in the future.

All five of the features in the table above satisfy these criteria. In addition, each feature has a special distinction that underscores its value as a named feature. We note that the AAD has a [policy and procedure](#) for assigning place names, which will be followed in any submission following these recommendations.

Islet in Sydney Cove

At the southern end of Sydney Cove, near Magnet Point on the northern tip of Laurens Peninsula, is a very small islet, with a sensibly horizontal top about 40m x 120m and nearly vertical sides about 100m high. Several structures of this islet are remarkable: (1) The sides, especially around the waterline, appear to be hexagonal columnar jointed, a common expression of cooling of thick lava flows. Good examples are [Giant's Causeway](#) in Northern Ireland and [Devils Tower](#) in Wyoming. (2) Prominent circular knobs on the top approximately 60cm in diameter and 40cm high, arranged in a rough matrix. Although there are several processes that could produce features similar to these knobs, we believe the only credible one for this location is columnar jointing. The prominence and uniqueness of this feature suggests that a unique name would be appropriate.



Figure 696 – The Islet March 2016 ●



Figure 697 – The islet is a fragment of the shoreline



Figure 698 – The top of the islet March 2016

Isthmus connecting to Red Island

Since 1874, the prominent rock at the northern tip of Laurens Peninsula has been referred to as "Red Island." It is not, however, obvious that it ever was actually an island. Satellite images from 2006 show that only 10 years ago the isthmus was a solid land bridge (although at most 3 m high), but the 2016 expedition documented that it currently is breached by recent channels on the east and west sides. This isolates Red Island and fully justifies the use of that term. But it also argues for a separate name for the isthmus, which, of course, is no longer literally an isthmus.



Figure 699 – Red Island and isthmus March 2016. This image has been stretched vertically by 2.5X. ●



Figure 700 –The channel (avulsion) in the isthmus

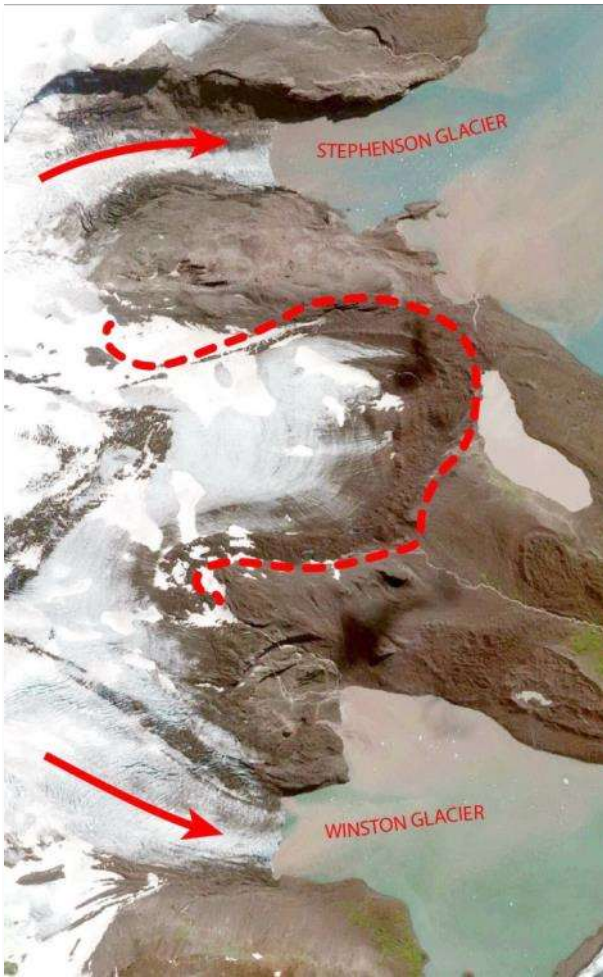
The question of naming of these features is slightly complicated. “Red Island” now should refer to the island alone. We suggest that a separate name now is appropriate for the isthmus. In addition, due to the special nature of the narrow channel on the east side (it allows water flow between the east and west sides of the isthmus), this channel (left) might benefit from a separate name, such as the “[X] Strait” or “[X] Channel.”

Glacier west of Stephenson Lagoon

The prominent glacier on the west side of the Stephenson Lagoon lies between the stubs of the Stephenson and the Winston Glaciers. The prominent terminal moraine, about 1.2 km in diameter, shows many ice exposing slumps. This feature is identified on the AAD Science Map No. 3 as AU1141.



Figure 701 – Photograph from the 2016 expedition



(Left) Figure 702 – Glacier AU1141 lies between the Winston and Stephenson Glaciers (Satellite image Google Earth 2006)

This feature is highlighted on the satellite image (Google Earth 2014) of the western edge of the Stephenson Lagoon. With the shrinking of the two bounding glaciers (Winston, Stephenson), this glacier assumes much more prominence. It therefore seems appropriate to give it a distinctive name.

Tarn west of Stephenson Lagoon

About 0.5km west of the Stephenson Lagoon is the tarn. It is about 0.25km wide and 1 km long, partially bounded on its west side by the relatively steep boundary moraine of Glacier AU1141, and on its east side by a relatively low mound. The water level in the tarn is at an elevation of about 30m ASL, and it carries a heavy sediment load. Along the NW boundary is a glacial slump that appeared in 2007 (documented elsewhere in this Report). To the north of the tarn a subsurface stream emerges carrying a large sediment load. It is not known whether this stream originates in the tarn or derives from the unnamed glacier to its immediate west. The ridge on the east side bounding the tarn shows scars of several channels that must have provided drainage.



Figure 703 – The tarn (center left)

During the 2016 expedition this feature was extensively documented. In particular, the 2007 ice slump was clearly documented (shown in the section on FIELD RESEARCH. In retrospect, the satellite image at right shows clearly the bare ice slope of the terminus “above” (*i.e.*, to the left in the image) created by the slump. Additionally, the stream seen to issue from the slump was found onsite to emerge essentially at the water level of the tarn, rather than as a jet or cascade. Clearly it is a subglacial stream.

The prominent stream apparently issuing as a drain from the tarn into Stephenson Lagoon was also found to be subglacial, and we found no evidence that it is a drain predominantly from the tarn. Rather, it probably is a drain from the glacier, hence is not directly connected to the tarn.

Between the tarn and Stephenson Lagoon there are numerous scars from channels that must have been direct drains from the tarn. Vegetation grows only on the west slope above the tarn.

Because it is the largest body of water on Heard Island that is not open to the sea, a name for this tarn would seem to be appropriate.



Figure 704 – Satellite image of the tarn west of Stephenson Lagoon 2014

Island east of Stephenson Lagoon

The creation of the Stephenson Lagoon joined two smaller lagoons (Stephenson Lagoon and Doppler Lagoon). The result was that Dovers Moraine on the east side of the lagoon became waterfront beach. For a time the lagoon was fully confined by the north and south breakwaters, and the area around the Spit could sensibly be considered still part of Heard Island proper. But in the last 10 years, the breakwaters have almost totally disintegrated, leaving the Spit surrounded by water, *i.e.*, it is now an island. Inevitably, it will undergo further erosion, reducing its size and perhaps creating erosional avulsions that will cut it into still smaller islets. Considering its history, prominence, and dynamic nature, a name for this island would be appropriate.

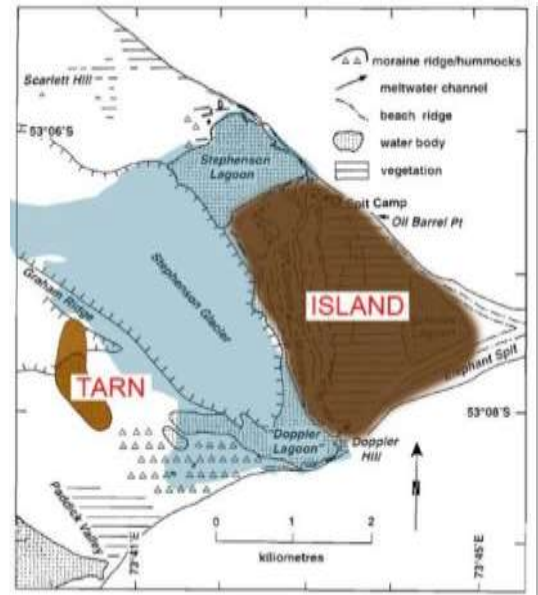


Figure 705 – The area around the Spit, including the newly formed island and the tarn west of Stephenson



Figure 706 – The island as seen from the north shore of Stephenson Lagoon

15. ACKNOWLEDGMENTS

The Cordell Expeditions team



Frederick Belton
KM4MXD

USA



Adam Brown
K2ARB

USA



Hans-Peter
Blattler HB9BXE

Switzerland



Alan Cheshire
VK6CQ

Australia



James Colletto
N6TQ

USA



David Farnsworth
WJ2O

USA



Vadym Ivliev
UT6UD

Ukraine



Kenneth Karr
NG2H

USA



David Lloyd K3EL

USA



Gavin Marshall
VK2BAX

New Zealand



William Mitchell
AEØEE

USA



Carlos
Nascimento
NP4IW

USA



Robert Schmieder
KK6EK

USA



Arliss Thompson
W7XU

USA



Rich Holoch KY6R
[co-Organizer]

USA

All pictures (except Rich Holoch) were taken on Heard Island 2016.

Acknowledgments

The onsite radio team consisted of Robert Schmieder KK6EK (Expedition Organizer/Leader), David Lloyd K3EL (Radio Team Leader), Adam Brown K2ARB, Alan Cheshire VK6CQ, Arliss Thompson W7XU, Bill Mitchell AEØEE, Carlos Nascimento NP4IW, Dave Farnsworth WJ2O, Fred Belton KM4MCD, Gavin Marshall VK2BAX, Hans-Peter Blattler HB9BXE, Jim Colletto N6TQ, Kenneth Karr NG2H, and Vadym Ivliev UT6UD. The onsite team was extended by the invaluable support of the vessel Braveheart: Matt Jolly, Bill Roundhill, Elliot Stead, Neil Broughton, Charlie Bedford, Nick East, and the vessel owner Nigel Jolly.

Rich Holoch KY6R was the offsite co-Organizer. Rich created and led the West Coast support group “Diablo DXers”, including Jack Burris K6JEB, Elliot Medrich N6PF, Daniel Brock WB4RFQ, Peter Hoffman W6DEI, and others. Especially important were Pete Bouget W6OP, who developed DXA Version 3; Mike Coffey KJ4Z, who implemented the remote radio operation and the AudioLog; and Tim Beaumont MØURX, who was the QSL manager. Additional support teams included the East Coast support group, led by Manny Rodriguez K4MSR; the Cape Town, South Africa, support group, led by Paul Johnson ZS1S; and the Northern Corridor DX Group in Perth, Western Australia, led by Keith Bainbridge VK6RK.

Scientific collaborators and advisors included Jodie Fox and Eric Woehler (University of Tasmania), Mary McGann (U. S. Geological Survey), Grahame Budd (University of Sydney), Erik van Sebille (Imperial College London), Steve Smith (OceanEarth), Callan Bentley (Northern Virginia Community College), and numerous others.

Expedition honors included Prof. E. O. Wilson (Harvard University, Principal Scientist), Prof. Joseph Taylor K1JT (DXpedition Leader), Jean-Michel Cousteau (Expedition Leader), Jim Smith VK9NS and Kirsti Jenkins-Smith VK9NL (DXpedition Dedication), and the “Fourteen Men” of the 1947 ANARE Expedition (Expedition Dedication).

Corporations making major donations in kind included HDT Global, Inmarsat, Inmarsat Government, Disc-O-Bed, Sound Seal, Acoustical Solutions, Elecraft, DX Engineering, Array Solutions, Arlan Communications, Spiderbeam, K1NSS Design, and numerous others.

Major funding support was provided by the Northern California DX Foundation, German DX Foundation, Oceania Amateur Radio DX Group, European DX Foundation, Danish DX Group, Northern California DX Club, Central Texas DX and Contest Club, Clipperton DX Club, GM DX Group, Swiss DX Foundation, Tokyo 610 DX Group, Southeastern DX Club, International DX Association, Twin City DX Association, Lone Star DX Association, CDXC The UK DX Foundation, Southwest Ohio DX Association, ARRL Colvin Award, Mediterraneo DX Club, Isle of Man DX Organization, Dayton Amateur Radio Association, the W. A. Tucker Foundation, and many others.

More than 5000 individuals made contributions to the project. Among the largest individual donors were Jan Poniwias DG2AT, Dave Anderson K4SV, Steve Hammer K6SGH, John and Cheryl Muhr KTØF/NØWBV, Zorro Miyazawa JH1AJT, Kan Mizoguchi JA1BK, Kip Edwards W6SZN, and David Bower K4PZT. More than 200 people donated more than \$100, and more than 30 people donated \$300 or more.

I am grateful to team members Alan Cheshire, Jim Colletto, and Dave Lloyd for editing and proofreading.



Figure 707 – Organizational sponsors



Figure 708 – In-kind sponsors

Almost 500 persons purchased souvenir mugs and tee shirts. Part of the purchase price was in support for the expedition.



The expedition carried the flag of the Explorers Club.



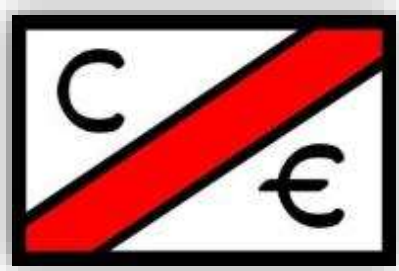


Figure 710 – The author would like to sincerely thank the thousands of persons and organizations who helped make this expedition happen.

Robert W. Schmieder

*Walnut Creek, CA
18 Feb 2017*

Cordell Expeditions



Australian External Territory Heard and McDonald Islands

