Title: Technologies for retrieving sediment cores in Antarctic subglacial settings

Dominic A. Hodgson, Michael J. Bentley,
James Smith, Julian Klepacki, Keith Makinson, Andrew M. Smith, Kevin Saw, Reed Scherer, Mike Rose, David Pearce, Matt Mowlem, Martin Siegert and others...

Target 6000 words
Royal Society's Philosophical Transactions A – Special Issue

Section contribution co-ordination
Dominic Hodgson/Mike Bentley – Introduction/compilation
James Smith/Keith Makinson – Beamish/Rutford corers
Kevin Saw/Matt Mowlem – surface corer on Ellsworth probe
Dominic Hodgson/Mike Bentley/Julian Klepacki – Ellsworth corers
Reed Scherer- modified borehole UWITEC multicorer (up to 50cm) (reed@niu.edu)

Invited:
Ross Powell - 5m hydraulic percussion corer (rpowell@niu.edu)
Slawek Tulaczyk- piston/gravity corer (tulaczyk@pmc.ucsc.edu)

Abstract
Accumulations of sediments from deep beneath the Antarctic Ice Sheet contain a range of physical and chemical proxies with the potential to document changes in ice sheet history and to identify and characterise life in subglacial settings. Retrieving subglacial sediment cores presents several unique challenges to existing sediment coring technologies. This paper briefly reviews the history of sediment coring in subglacial environments. It then outlines some of the technological challenges and constraints in developing the corers being used in sub-ice shelf settings (e.g. George VI and Larsen Ice Shelf), under ice streams (e.g. Rutford Ice Stream), at or close to the grounding line (Lake Whillans) and in subglacial lakes deep under the ice sheet (e.g. Lake Ellsworth). The key features of the corers designed to operate in each of these subglacial settings are described and illustrated together with comments on their deployment procedures.

1. Introduction

1.1 Why retrieve sediment cores from subglacial settings ?

Sediments accumulate in many aquatic environments. Where the water column is stable, sediments can retain their layered stratigraphy and, with their range of incorporated environmental proxies, provide long term records of environmental change. The presence of layered sediments in Antarctic subglacial environments has been confirmed by seismic profiling, (Composite fig 1 showing geophysical evidence of sediment deposits beneath AIS).... These have shown deposits ranging from at least a few metres (Lake Ellsworth; Smith et al.,2008; Bentley et al., 2011) to hundreds of metres thick (Lake Vostok, Filina et al., 2007; 2008) (Bentley et al., 2011). Moreover, the presence of sequences of layered sediments has been established from former subglacial lakes (e.g. Hodgson et al., 2009a; 2009b).

So far sediment cores from former subglacial settings and from Subglacial Lake Whillans have been retrieved and have been analysed to provide records of glacial history and the presence of life.

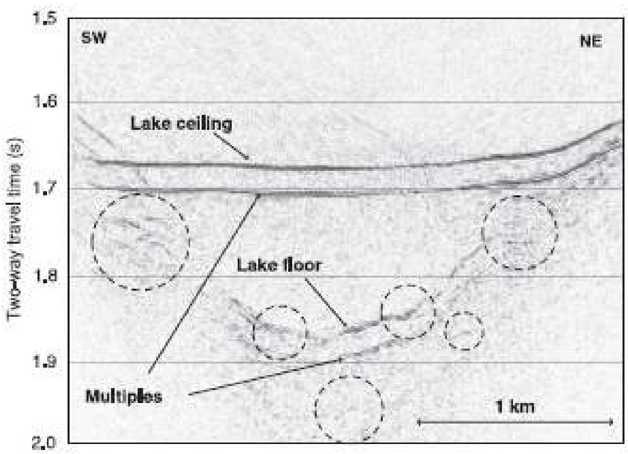

Fig. 1 Seismic reflection profile beneath sub-glacial Lake Ellsworth showing sediments in lake. [could add some of work from Vostok too – see Bentley et al 2011 review Plate 1.]

Ice sheet Glacial history

Sedimentary basins within lake basins, channels and former seaways under the Antarctic Ice Sheet (AIS) all have the potential to provide records of the overriding ice sheet history and changes in subglacial hydrology (Siegert et al., xxxx; Bentley et al. 2011). Under the West Antarctic Ice Sheet (WAIS) these records are particularly valuable as they have the potential to evaluate its present-day stability over glacial-interglacial cycles. The history of the WAIS, and in particular the date when it last decayed is not known; yet is critical to assessing the present-day risk of ice sheet collapse and consequent sea-level rise. Far field records show sea levels were 3-20 m high than present during previous interglacials suggesting that one or more of the major ice sheets were substantially smaller than today. During the last interglacial (Marine Isotope Stage 5e, 127–118 ka), temperatures in Antarctica were up to 6 °C higher (Sime et al., 2009) and global sea-level peaked at least +6.6m (95% probability) (Jansen et al., 2007; Kopp et al., 2009); in Marine isotopic Stage 11 (420 to 360 ka) - the closest analogue to our present interglacial in terms of orbital configurations and (pre industrial revolution) atmospheric greenhouse gas concentrations - sea levels have been estimated at +20 m. It is not known how much the AIS contributed in total to each of these events, or indeed which parts of West or East Antarctic Ice Sheets saw major volume changes. Specific targets for sediment core records therefore include: (i) the former seaways that were established during the last ice sheet collapses (Barnes et al., 2010; Vaughan et al., 2011); (ii) lake basins in fjord settings such as Lake Ellsworth, which are likely to have accumulated marine sediments during the previous collapse(s) of the WAIS (Bentley et al., 2011), and (iii) sites at or close to the grounding line which will shed light on past and present grounding line dynamics (e.g. Christner et al., 2014; Smith et al (JAS ref?))).

Such grounding line dynamics can be on various timescales. In the case of interglacial WAIS collapse one model (DeConto, XXXX) has identified the interior flank of the Bentley Subglacial Trench in the centre of the WAIS as the site of early ice-sheet decay. In trying to understand changes in the Holocene and in the future, field observations of ice thickness change and imaging of the sea floor suggest that the ice stream margins of the ice sheet in the Amundsen Sea sector are most sensitive to decay on account of their reverse bed slopes and the influence of warm circumpolar deep water on melting the ice sheet base (refs from JAS). In contrast, with the exception of some marginal glacial troughs, the East Antarctic Ice Sheet (EAIS) is considered more stable (Sugden refs) and has persisted in some areas for at least 15 million years. Here sediments may have accumulated in stable basins (e.g. Lake Vostok) providing a long-term record of the EAIS. Geophysical surveys in settings such as Lake Vostok support these showing thick deposits of layered subglacial sediments (Bentley et al., 2011). These would potentially be easier to interpret compared with sedimentary records redeposited at the margins of the ice sheet, such as from ANDRILL, where the relative contributions from West and East Antarctica can be less easy to decipher.

Life in subglacial environments

The other area of considerable research involves the identification and characterisation of life in subglacial settings. This includes understanding the origin of life found there and also the biological process used to survive under extreme pressures, absence of light and limited nutrients. There is also speculation that unique life forms may have evolved to survive in these environments following the formation of the Antarctic Ice Sheet. This is particularly the case for the EAIS where some subglacial environments may have persisted since the early Cenozoic. Under the WAIS the repeated deglaciations will have exerted different evolutionary pressures and studies so far indicate that at least some of the life forms present are derived from marine organisms present during interglacial periods when the ice sheet was absent (Pearce ref). Because most of the conditions required for life are best met at the sediment-water interface the focus here is on collecting intact surface sediments and in analysing accumulated sediments for biogeochemical signatures that life persisted there. These studies are contributing to knowledge on how microbial life exists in extreme environments, which is relevant to understanding the evolution of life both on Earth, during periods of global ice cover (i.e. Snowball Earth ref) and potentially on other planets such as the Jovian moon Europa, which has a liquid ocean beneath a crust of ice.

In order to address these questions of ice sheet history and life in subglacial environments, sediment samples are needed from beneath the ice sheet. This is technologically and logistically challenging. This paper briefly reviews the history of sediment coring in subglacial environments. It then outlines some of the technological challenges and constraints in developing corers for use in sub-ice shelf settings, under ice streams (Beamish), at or close to the grounding line (Lake Whillans), and in subglacial lakes deep under the ice sheet (Lake Ellsworth).

2. Brief history

The first (?) sediment samples from beneath the Antarctic Ice Sheet were extracted from a deformable clay rich diamicton at Ice Stream B (Scherer et al 1998), located in an area of the Ross Sea embayment that would have been inundated with seawater during periods of WAIS retreat. A piston corer was used to recover cores up to 4 m long in hot water- drilled access holes through

1030 m of ice. The sediment surface was about 600 m below sea level. The diatom composition of the samples was dominated by upper Miocene taxa, but four of the samples contained Quaternary diatoms and high concentrations of beryllium-10 which provide evidence of a late Pleistocene or Quaternary retreat of the grounded ice sheet in the Ross Sea sector. A CalTech piston corer was used in this study but no stratigraphic analyses were presented. Further information on the corer design is provided below (Reed to contribute here?).

The first (?) stratigraphic analyses of an Antarctic subglacial lake setting were of sediment cores collected from Lake Hodgson, situated at a retreating margin of the WAIS on Alexander Island (Hodgson et al 2009a and b). Here the lake was relatively accessible having emerged from under more than 297–465 m of glacial ice during the last few thousand years. Sediments were collected using a UWITEC gravity corer, then three overlapping 2 m long cores were taken with a UWITEC KOL Kolbenlot manually operated percussion piston corer to a total sediment depth of 3.76 m. A multidisciplinary investigation suggested the sediments had been deposited since the last interglacial and that the lake persisted in a subglacial cavity beneath overriding Last Glacial Maximum ice with a transition from coarse to fine grained sediments marking the onset of Holocene deglaciation. Evidence of biological activity was sparse. Organic carbon was present (0.2 to 0.6%) but the d13C and C/N values suggested that much of it could be derived from the incorporation of carbon in catchment soils and gravels and possibly old CO_2 in meteoric ice. The gravity and percussions corer used in this study are commercially available and required no special modifications.

Lake Whillans sediment core retrieval (Reed, Ross, Slawek) – few sentences on what was achieved

Sub-ice shelf settings – JAS to add few sentences on what has been achieved here by him and others

(Check if cores were collected in Kamb Ice Stream in addition to the borehole camera images)

3. Coring technologies

A variety of sediment samplers have been developed for use in different subglacial environments. These range from short corers designed to collect an undisturbed sediment-water interface to gravity corers which penetrate deeper sediments under their own mass. For deeper and stiffer sediments (e.g. glacial tills) corers with hydraulic and electromechanical percussion hammers have been designed to enable more efficient penetration.

3.1 Sediment corers developed for sub-ice shelf and sub ice-stream settings

Sediment corers have been developed for extracting sediments from hot water drilled (HWD) access holes in sub-ice shelf settings to record the history of ice shelf advance and retreat and from under ice streams to provide an observational basis for understanding fast ice stream flow mechanisms and to interpret ice sheet history. These corers have typically been developed as (relatively) lightweight manual percussion corers (Fig 2a and b) that use a common deployment system and tether with other field instruments and are compact enough to be transported by a DeHaviland Twin Otter aircraft. Mini gravity corers have also been deployed to collect surface sediments (Fig 3). Below we describe corers developed by the British Antarctic survey in collaboration with Austrian engineering company UWITEC.

The main instruments developed for coring in these subglacial settings are manual percussion corers. These consist of a core cutter, core catcher, lined barrel, and valve with percussion driven via a manually operated hammer mounted on a hammer rod with a striking plate (Fig 2a). The corer is connected to the surface via a (X - 2,600 m) length of maxibraid attached to a skidoo via an A-frame sheave. The assembled corer is positioned upright in the hole and supported by a temporary brace before adding the hammer rod and weights. The corer is then shackled to the winch cable via a c. 7 m tether rope attached to the lowermost hammer weight. The brace is then removed and the corer lowered to the sea-floor at 20-60m/per minute. Previous measurements from the HWD drilling system and a slackening of rope tensionand/or a change in the load (from a load cell mounted on the sheave wheel) are used to determine when the corer cutter head, and then the hammer weights hit the sea-floor (or subglacial bed) and bottom hammer plate respectively. From this point, the weights are lifted up and down by c. 1.5 m to ensure that the corer remains upright, hammering continues until the rope has stopped paying out, or has extended by the same length as the corer barrel. Once back at the surface, the corer is clamped in its brace and the hammer rod and weights removed. The corer can then be lifted out of the hole, laid horizontally and the liner extracted. Three X kg hammer weights have been found optimal in soft homogenous muds with minor components of sand but additional weights can be added to penetrate gravelly mud/glacial diamictons. (James – add some text on new hammer auto-release mechanism). A simple mini-corer (Fig 3) has also been used to collect undisturbed surface samples and typically penetrates the sea floor by 10-20 cm.

3.2 Sediment corers developed to sample sediments in the grounding zone
(Most of this extracted from WISSARD website – so some rewriting required)

Sediment cores from the grounding zone can provide important information on ice sheet dynamics. The WISSARD programme developed three sediment corers to sample sediments from the grounding zone of the WAIS in the Ross Sea to assess the future stability of the West Antarctic Ice Sheet in this region.

To retrieve intact surface sediments a lightly modified off-the-shelf system supplied by the Austrian company UWITEC was designed to take three replicate cores (Fig. 4). On striking the bottom sediment during descent a self-triggering core catcher is deployed to recover an undisturbed sediment-water interface and surface sediments in each of the three core liners. Thus it is also an effective bottom water sampler. It also comes with a custom sediment slicer with which you can extrude sediment in discrete intervals for sequential sampling through the top-most lake sediment.

A piston corer (Designed and built by University of California Santa Cruz) was developed to collect a non-deformed sediment core. The piston corer is modelled on the previous CalTech corer (Fig. 5) and has its own light-weight winch and cable....more text required

To retrieve deeper consolidated sediments a hydraulic percussion corer was used. The percussion corer (Figs. 6 and 7) is designed to be lowered to the lake or sea floor on the smart cable of a multipurpose winch, and then hammer a core barrel up to 5m-long into stiff over-consolidated sediment such as subglacial till. This design has the potential to extend sedimentological sampling studies beyond the range currently accessible using gravity coring. As the percussion corer is deployed, a 2000lb mass is released within its casing by unbolting an extension section from inside the casing (refer to pink section in Fig. 6). Once deployed at the sediment surface, the hydraulic motor is commanded to drive a piston that raises the mass to its maximum height within its casing, and then is tripped to be released in a free-fall, to then strike a plate on the top of the core barrel. This process is automatically repeated every 20-30 seconds until commanded to stop.

A linear position sensor is used to measure the penetration distance with each strike. Coring is stopped when there is either a lack of further penetration or the 5m-barrel is fully buried in the bottom sediment. To avoid large pullout strains beyond the capacity of the cable, which is 10,000lb, the hydraulic system is designed to help extract the core barrel. The hydraulics can be commanded to force pressurized-water down between the core liner and core barrel; the water exiting via jets through holes in the core cutter head (Fig. 7). The water is then forced up the outside of the core barrel to decrease friction between it and the sediment.

Also for added safety if the hydraulic flushing process fails to extract the barrel, weak-link bolts that fail in tension will break away at the top of the barrel so that the rest of the corer assembly can be recovered and only the barrel is lost.

3.3 Sediment corers developed for deep continental subglacial lakes

Deep continental subglacial lakes present an additional range of technological challenges (Table X), not least of which is the depth required of the HWD, but also the low temperatures and high pressures experienced there.

For the Lake Ellsworth programme a short corer was designed to sample a few centimetres of sediment from the lake floor, including an intact sediment-water interface which was considered the most likely location to find evidence of life. The corer was mounted on the tip of the lake probe and consisted of a corer barrel (dimensions) with an electronically activated core catcher (Fig 8). A downward facing camera and light source enables the corer to be lowered precisely onto the sediment before the core catcher is activated electronically from the surface. On retrieval up the ~ 3km HWD hole the narrow diameter sediment core was expected to freeze. The corer was designed to be detached from the probe to extrude the (frozen) core sample with the intact sediment-water interface.

The percussion corer for Lake Ellsworth (Fig 9) was designed to be deployed after the lake probe had been retrieved. This would be deployed on a single load bearing tether that houses x4 power cables, x2 twisted pair cables, x6 single-mode fibre-optics and x1 coaxial cable and is shared, together with common couplings, by the UV cleaning unit, and the lake probes. The corer was designed to be deployed 'cleanly' so was assembled under clean conditions (Fig 10) and stored within a sterile deployment system with identical couplings to that designed for the lake probes and UV probe.

(Note: the following will be edited to have a consistent level of detail with earlier sections)

The percussion corer is a mechanically driven percussion piston corer. It is effectively two assemblies: The control interface (CI) housing with Piston-Rod (PR) and fixed piston as one assembly and Hammer Unit (HU) with Core-Barrel (CB) as the other. At the sediment surface the core barrel is designed to be driven down past the fixed piston by a percussion hammer actuated by a pair of linear motors in a hammer unit (HU, Fig 11). When the barrel is full, or when there is no more sediment penetration a corer clutch (CC) is deployed to prevent further movement of the piston in the core barrel and deformation or loss of the sediment core. The CI on the corer houses the power converters, control electronics and communication modems (Fig 13). Cameras and light sources provide information on the operation and progress of the corer. One camera is located inside the Piston (Fig 12b) aiding descent and to position the piston precisely at the sediment water interface. It uses halogen lamps to prevent the piston freezing into the core barrel (there is also a heat-trace cable within the PR to prevent it freezing to the HU). Another with LED lamps monitors the Piston-Rod-Clutch and Clutch-Camshaft. The final camera with LED lamps is located at the top of the corer housing looking upward to identify any changes in inclination angle (i.e. if corer starts to topple) and to aid ascent. Communication is via the tether which is connected to a Deck Unit (DU) housing the communication and video interfaces, linked to a 0-600VDC 2.4kW DC Surface-Supply that delivers power to the entire system (SS) and a Guardian K-DVR-4G, 4-channel composite Digital Video Recorder (DVR). The CI provides the bi-directional communication to the DU, control for the HU and local instrumentation. A more detailed description of the main system components on Fig 9 follows.

The Hammer unit HU (Fig 11) provides the corer with hammering action to penetrate the sediment and is coupled to the corer-tube. The HU and associated core-tube slides over the fixed piston-rod, which is attached to the control interface. An umbilical cable connects the HU and the CI and provides power and communications between the two units. The HU consists of two linear-motors coupled to a steel weight. On actuation the linear-motors lift the weight and drop it, repeating this action until deactivated. This cycle period takes ~750ms. The HU also houses the linear-motor controllers, programmed to dictate operational positions, stroke, acceleration, discrete/continuous operation etc. They are programmed with manufacturer available designer software; Linmot Designer and Linmot Talk. Motors take a nominal operating voltage of 54VDC with a maximum current consumption of 15A. The controllers require a supply of 24VDC at typically <1A (~100mA). The HU also houses the Corer-Clutch (CC, Fig 12a), this is used to lock the HU against the PR. With the CC engaged bearings are held in 'profiles' machined into the PR, this prevents the HU travelling along the rod and enabled the whole assembly to be manoeuvred by the CI, which sits above the HU. On deactivating the CC the bearings are released and allow the rod to pass by. This allows the HU and core-tube to slide down the PR as it penetrates the sediment. A depth sensor is positioned close to the PR and activated by the machined profiles. This is translated at the DU as a graphical indication of depth penetration of the core. As the HU moves down the PR, this causes the Piston inside the coring-tube to retract/lift within the coring-tube. This action maintains neutral pressure within the coring-tube and prevents the core-sample from becoming compressed and damaging the sample structure. On completion of the coring process, the CC is then reactivated to lock the HU against the PR and allow retrieval without disturbing the core-sample. A camera is used to monitor the CC position giving visual display at the surface of its operational status.

Prior to first deployment the CI and the HU are held in place and 'tied' together with shear-pins. These shear-pins prevent the HU from sliding down the piston-rod. Once the corer is in position and hammering commences, after a short number of hammer blows (<10) the shear-pins, shear and the HU + core-tube are free to slide down the piston-rod and into the sediment. For transit purposes the CI and HU are bolted together, these bolts must be removed, leaving only the shear-pins prior to deployment. Once coring has finished the HU and CB need to be locked in position relative to the piston rod. This is so not to destroy the core sample on retrieval of the corer. Failing to do this would result in the piston travelling further upward within the core barrel and 'sucking' up the core sample with potential for damage to its integrity. The locking is achieved by using ball bearings locked into profiles in the piston rod by a locking sleeve (Fig. 12a). A summary of the deployment procedure is shown in Fig 14.

At the top of the corer the Control Interface (CI) houses the power converters, control electronics and communication modems. Power for the HU linear-motors is provided by x3 375/54V 600W DCDC converters operating in parallel. Power for the motor controllers is provided with a single 375/24V 150W DCDC converter. This also provides auxiliary 24V power. Main control electronics is powered by a 375/12V 150W DCDC converter. The main control-electronics are microprocessor based and control the 54V DCDC converters and also the 24V DCDC converters. It also controls the clutch-motor, activating the CC and camera lighting. Also within the CI is the communication modems and video interface. A serial-optical modem provides primary communication with a secondary modem for redundancy. The serial-optical modem interfaces the single-mode optical input to RS232 output, the secondary modem is RS485-RS232. Video interface is provided with composite-video to fibre-optic converters. Power and optical connection between the CI and DU is provided by the tether.

At the surface power is supplied to the corers by a Glassman LP 600-4 2.4kW DC supply. This gives a controllable 0-600V DC supply with a maximum output of 2.4kW and connects via the Tether (2.5mm^2 copper conductors) directly to all the DCDC converters contained within the CI. Control is via a Deck Unit (DU), consisting of a PC running Windows OS, control software (LabView) and a 3U enclosure housing the communication and video interfaces (Guardian K-DVR-4G, 4-channel composite video recorder). The system is controlled using a Graphical User Interface (GUI) which is a LabView virtual instrument that performs the control and interrogation of the corer with a Serial-fibre modem for GUI to CI communication and fibre-composite converters for video output. .

Ellsworth gravity corer

In the case of a communication failure in the tether and to provide redundancy for the precision piston corer, a simple mechanical gravity corer was constructed with minimal moving parts (Fig 15). Gravity corers typically have a high sampling success rate (in ship-based deployments) but have the disadvantages that they can over-penetrate or compress the sediment. An x cm core barrel was used with x Kg of head weights to achieve a reasonable balance between corer diameter (a narrow corer penetrates further into (older) sediment), corer weight (greater weight gives greater penetration but requires a stronger cable to retrieve).

This corer can be operated by lowering on xx cable and is driven by gravity into the sediment. It is retrieved by ……….

Other coring technologies for future work

Other features, such as vibration or rotation to penetrate deeper sediments

Comments from all authors please……

Acknowledgements

References

Tables

Table 1 – Summary features of all corers...please complete your section

Figures

(Note : these are current suggestions for figures and you will see that some are just lifted from our websites and need updating – where possible to show their use in Antarctica. Please feel free to modify any figures to match your text contributions)

Fig 1. Composite fig showing geophysical evidence of sediment deposits beneath AIS (MB?)

Figure 2. Beamish corer (a) schematic diagram and (b) photographs....

Figure 3. Beamish surface corer

Figure 4: Uwitec multicorer that takes three replicate cores at once preserving the top-most sediment, the sediment-water interface and the water column. Two bottom right images show a sample being recovered.

Figure 5. WISSARD piston corer. Preparing and deploying the UCSC piston corer. Bottom right image is from the ROV of the protruding bent core barrel with its lower section being in stiff till.

Figure 6. WISSARD hydraulic percussion corer. DOER engineering CAD of the NIU Percussion Corer (Designed by DOER-Marine and S. Vogel and built by DOER-Marine)

Figure 7. (a) Upper stages of the WISSARD hydraulic percussion corer including the power and hydraulic motor stage and the telemetry stage. Below these is the drop-weight stage (the weight can be seen through the holes at the bottom of the stage in image on the left. (b) Unbolting the extension section to release the drop-weight before deploying the percussion corer. On the right, the corer is at its full extent with the 5m core barrel being the lowest stage.(c)Specifics of the core barrel of the percussion corer. Clockwise the images are: water jet holes at the base of the drop-weight stage that attaches to the top of the core barrel; top flange of the core barrel with water jet holes; linking the base of the drop-weight stage to the core barrel (two images); core cutting head; looking up the core cutting head at the core catcher; the core liner exposed without the core barrel attached to the core cutter with custom sealing ring with water jet holes.

Figure 8. Ellsworth probe with short corer, plus detail of the core catched mechanism

Figure 9. Ellsworth Percussion corer schematic

Figure 10. (a) Sterile assembly system for the Ellsworth probes and corers and (b) the percussion corer in its transit case

Figure 11. Ellsworth percussion hammer

Figure 12. (a) Ellsworth percussion corer piston and (b) control unit showing the mechanical configuration of the clutch locking assembly. The piston rod has radius grooves machined every 100mm. The clutch is made up of a boss housing a series of ball bearings held in place by two O-rings. A locking sleeve is then held above the clutch by a camshaft orientated at its highest profile. The internal diameter of the locking sleeve only just clears the outside diameter of the ball bearings. With the locking sleeve held above the bearings there is clearance for the bearings to move following the profile of the piston rod. The clutch camera approximate field of view is shown within Figure x1 and Figure x2 as the area within the red circle.

If the camshaft is rotated approximately 70 degrees, it removes its support of the locking sleeve and the sleeve is clear to drop. In this situation when the bearings align with radius grooves of the piston rod. The locking sleeve shifts the bearings inboard into the piston rod radius grooves. The locking sleeve drops and becomes fully seated and the bearings lock the piston rod at its present position. Figure x2 illustrates the clutch assembly in its locked position.

Figure 13. Ellsworth percussion corer control unit

Figure 14. Ellsworth percussion corr deployment procedure....

Figure 15. Ellsworth gravity corer

---------- Forwarded message ----------
From: **M J Siegert** <M.J.Siegert@bristol.ac.uk>
Date: 5 February 2014 12:20
Subject: Royal Society meeting on subglacial exploration and associated publication
To: jmikucki@utk.edu, David Pearce <david.pearce@northumbria.ac.uk>, bulat@omrb.pnpi.spb.ru, bulat@lgge.obs.ujf-grenoble.fr, "Parnell, John" <j.parnell@abdn.ac.uk>, Helen Amanda Fricker <hafricker@ucsd.edu>, "Le-Brocq, Anne" <a.lebrocq@exeter.ac.uk>, "fpattyn@ulb.ac.be" <fpattyn@ulb.ac.be>, Duncan Young <duncan@utig.ig.utexas.edu>, tulaczyk@pmc.ucsc.edu, "Michael J. Bentley" <m.j.bentley@durham.ac.uk>, "Hodgson, Dominic A." <daho@bas.ac.uk>, Peter Barrett <peter.barrett@vuw.ac.nz>, German Leitchenkov <german_l@mail.ru>, lipenkov@aari.nw.ru, "Makinson, Keith" <kmak@bas.ac.uk>, frack2@unl.edu
Cc: "<jpriscu@montana.edu>" <jpriscu@montana.edu>, "Lyons, William" <lyons.142@osu.edu>, "<alekhina@aari.ru>" <alekhina@aari.ru>, "<j.l.wadham@bristol.ac.uk>" <j.l.wadham@bristol.ac.uk>, philtransa <philtransa@royalsociety.org>

Dear Jill, David, Sergey, John, Helen, Anne, Frank, Duncan, Slawek, Mike, Dom, Peter, German, Vladimir, Keith and Frank,

Many thanks for agreeing to give a talk at next year's Royal Society meeting on "Subglacial Antarctic Lake exploration: first results and future plans", 30-31 March 2015.

I, and on behalf of my co-editors, am delighted to let you know that papers from our conference have been approved for publication in the Royal Society's Philosophical Transactions A series (subject of course to peer review etc.).

Before official invites are sent to you, with appropriate instructions on how to format and submit a paper etc, could you first let me know if you are willing to write a paper for this volume? While we'd like you to lead your papers, we also encourage you to collaborate an co-author with other scientists you know, as you see appropriate.

The schedule for both submission and handling of papers will be as follows:

Publication in January 2016.

Manuscripts submitted: 13th April 2015 (2 weeks after meeting)
Peer review: April-June 2015
Revisions: June-August 2015
Revised manuscripts received by: September 28th 2015
Final issue deadline: 26th October 2015.

So, we have 14 months from now to get the papers written!

Let me know if you're able to do this as soon as you can, please. I'd be happy to discuss the nature of the content with you if you wish - just let me know.

With very best wishes,

Martin Siegert

and on behalf of John Priscu, Irina Alekina, Berry Lyons and Jemma Wadham

cc. co-convenors and 'Phil. Trans. A'

Dear Jill, David, Sergey, John, Helen, Anne, Frank, Duncan, Slawek, Mike, Dom, Peter, German, Vladimir, Keith and Frank,

Many thanks to all of you for responding so positively about providing papers for the Phil. Trans. volume associated with next year's Royal Society meeting on subglacial exploration. With all of you providing papers, the volume looks set to be a great contribution to our field.

You'll each know the remit of your papers. Do get in touch with me (or any of my co-editors John, Irina, Jemma and Berry) if you want to discuss content specifics.

Authorship
While we'd like you each to lead your papers, we are very happy for these to be multi-authored contributions. We therefore encourage you to contact collaborators on joining you as co-authors in your papers.

Length
As there are 15 papers plus the introduction planned for this issue, and each issue should be around 200 pages long, please ensure that your paper will be no more than 12 pages in length. As a guideline, 12 journal pages is equivalent to around 6000 words of text (including references), 200 words of tables and 4 figures. Each paper must contain an abstract of up to 200 words, and 3-6 keywords.

LaTeX files
Authors are advised to use the rsproca class file (available at http://rsta.royalsocietypublishing.org/site/misc/style-guide.xhtml) to accurately estimate the length of their manuscript. A template is available from the Editorial Office on request.

Supplements
We encourage you to think about additions that could add extra value to your paper. This could be in the form of additional information for your paper (e.g. data, tables, figures, text, movies etc.) or more general things such as interviews with the authors, audio files from presentations etc.

Schedule
As all papers in a particular issue publish together, publication can be significantly delayed by the last paper to be submitted. We want our issue to be timely and for papers to be published as quickly as possible, so prompt submission and quick turn-around of revisions will be appreciated. Here then is a reminder on the planned schedule. Please let me know if you are concerned about being able to meet any of these dates.

Publication in January 2016.
Manuscripts submitted: 13th April 2015 (2 weeks after meeting)
Peer review: April-June 2015
Revisions: June-August 2015
Revised manuscripts received by: September 28th 2015
Final issue deadline: 26th October 2015.

Finally, I enclose some Instructions for Authors, which you will find useful as your papers develop.

You will be contacted individually shortly with an official invite from the Royal Society to provide the paper, but I thought you (as a group) would appreciate some information at this early stage.

Do let me, or any of the co-editors, know if we can help with anything.

With best wishes,

Martin Siegert

Spare text

Figure XX. Lake Ellsworth Percussion Corer Graphical User Interface. 1. **VSupply** displays the supply voltage to the corer interface.. 2. **Rod Temp & Int Temp** displays the Piston-Rod (PR) temperature and the Control Interface (CI) Housing temperature respectively. The PR has a heat-trace inserted with aim to keep the Rod at a temperature above freezing to prevent the freezing of water between the PR and Hammer Unit (HU) and around the Piston-Rod-Clutch preventing locking of the PR on core retrieval. 3. **LOG ON/LOG OFF** implements logging of the acquired parameters to file. 4. **Graphical Plots.** The last 30 minutes trend of Supply voltage, DC-DC voltages and Corer temperatures are given for historical information. 5. **DC-DC Voltages** displayed for prior testing and confirmation. 6. Co**ntrol Panel** allows the control of operating voltages and activation/deactivation of the hammer. To prevent accidental switching each function requires a two stage operation. 7. **Depth.** This indicates the depth that the corer has achieved and aids potential progress diagnosis. The slider-bar fills to the depth penetrated. 8. **Modem.** Two channels of communication are available. A fibre optic modem and a copper wire modem as back up. Selection between the two modems is achieved through this button and can be operated during communication, switching between the two modems if necessary. 9. **Rod-Lock Control & Cam-Count.** enables the Rod-Lock function to help prevent accidental operation of the Rod-Lock during hammering. 10. **COMMS ON/COMMS OFF** starts communication with the corer. 11. **STOP** the execution of the GUI program. 12. **Current Log File** gives the location of the most recent logged file. 13 **Control Panel** allows the activation of the *Piston Rod-Lock*, once enabled via the Rod-Lock Control numbered 9. 14. *Camera+Up Lights* activates the three cameras within the corer. *Up Lights* correspond to a set of LEDs for the upward facing camera and a single LED for the Clutch camera. *Piston Lamps* are a set of 12V halogen lamps inside the piston. These help keep the piston warm and prevent seizure through freezing water. The lamps require the 24V source to be enabled before operation. 14 **Raw Data** shows the raw data coming from the corer microcontroller and is primarily used for fault diagnosis.