# MSCL-S Standard Operating Procedure:
## WHOLE CORE LOGGING

April 2020

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## Set Up Day before

Use core liner (180cm) and 12 end caps provided by facility user (6 x 30 cm pieces for calibration). Create 6 calibration pieces from the liner supplied with ends sealed. These should be prepared and filled, with the brine or distilled water and placed in the laboratory overnight to acclimatize to the room temperature.

If liner is not provided, use closest type available and explain the limitations of the calibration.

Brine solutions:

Make up brines to correct concentration using 1 g = 1 ppm in 1 litre of water

Fill two jugs of tap water and place in the MSCL laboratory to acclimatise

Aluminium calibration pieces:

Check available gamma density calibration pieces to fit the core liner provided, use callipers to measure the depth of each Al step (in cm).

Sediment core labelling:

Remove sediment cores from cold store to acclimatise within the MSCL laboratory. Ensure way up markers are all facing upwards, or that the cores are aligned before acclimatization to ensure fluids have settled in a consistent manner across the sediment core set. Use red dots to indicate top surface for logging, and maintain way up throughout the logging procedure. If there is a manufacturer's stamp on the core liner, this should be facing upwards and the mark should be on the upper surface.

Check sediment cores are labelled appropriately and the sediment core section labelling reflects the run through the MSCL-S, clean core liners, and remove all unnecessary tape from around the caps. Record details of the sediment cores being logged; including the order and whether multiple sediment cores will be logged in one session. Always note section numbers, spacer separations, and any blanks in the log sheet.

## Logging Day

### Calibration File

A copy of the calibration sheet should be saved to the data folder for the sediment core, one calibration is required per day.

### File Naming

Files need to be named with the cruise and sediment core code, if multiple sediment cores are run in one file, it should be in order of sediment cores run and include GC/PC description, and the date:

**General software set-up**

Check for "Horizontal" (whole) or "Vertical" (split) set up in Utilities. Open Utilities – Window – Settings, from menu, in pop up screen check "vertical" or "horizontal" (split or whole). The one in bold is the one running.

Check this is applied under the Magnetic Susceptibility tab, point sensor is for split core, which should select automatically when settings are changed to vertical. If this requires to be changed, go to the general tab, "current settings file", pick vertical (split) or horizontal (whole) from drop down menu.

You must close the window, then reopen it to check that the change has occurred.

**Running back to back sediment cores**

Record on the log sheet the section numbers that are in the data file.

Use tap water filled core liner as separator, make a note of the section numbers that will be represented by the separator. Split sediment core separator – fill an empty liner with polystyrene to create an artificial spacer for the sediment cores, must be in filled and 25cm long section.

**CALIBRATION:**

**Gamma Density – whole core**

- Fully open the source lever
- Utilities software: Window, test panel, Gamma Density
- At the time prompt select 30 seconds
- Using the appropriate Aluminium calibration piece, ensure accurate measurements for each thickness section (cm) are recorded and there are a minimum of four sample thicknesses for the calibration in addition to the distilled water sample, record thicknesses in centimetres on the log sheet.
- Insert calibration piece into a representative core liner with sealed ends.
- Ensure no air bubbles, or large gaps and calibration piece is flat and centred, fill with acclimatised water, water should completely cover the calibration piece. Thicknesses should be marked on the exterior of the liner.
- Push into place between the source and detector, ensure that end-caps or tape are not obstructing the measurement of the calibration.
- A blank reading must be taken with no calibration piece and out the influence of any end caps or tape.
- Record the "Corrected CPS" for three repeats and use the average in the calibration log sheet. Check for consistency between the three measurements, ensure measurements are not recorded when the piece has been moved or when the water may still be moving in the piece.
- Enter values into the calibration spreadsheet and check the quality of the fit is $R^2>$

0.99.  A poor $R^2$ value is likely to occur if the calibration piece is misplaced or off centre.

- Use the log sheet to record the A, B and C parameters from the regression calibration generated in the spreadsheet.
- Ensure the positive or negative values are recorded and that they are entered correctly into the logging software, this is a common source of error, both the A and the B parameters can be negative, this must be entered correctly.

**Resistivity - whole core**

- Ensure sensor is clean and dry, and core liner is clean and dry as well.
- Check that a core section placed onto the resistivity sensor slightly depresses the sensor below the rails, if it does not visibly move, adjust the sensor height.
- Set up the calibration pieces: Ensure the calibration pieces are completely filled with brine (N.B. 0.35 ppm calibration piece is filled with tap water).
- Open utilities, zero the resistivity sensor, ensure no calibration pieces are on the sensor and that the sensor is clean and dry.
- Zero the resistivity *twice*, wait for the "ready" prompt before continuing.
- Open the resistivity calibration option, enter 1 second, then record the background value. Re-zero if the value is significantly above or below zero, and check that the values are relatively steady, if significant changes are observed, then check sensor for dirt or water, in the correct position, re-zero and try again.
- Place the calibration piece on the sensor for 30 seconds and ensure the values are consistent, they will change when moved or disturbed.
- Using each brine concentration in turn, place the calibration pieces on the sensor and record a representative reading from the calibration window, record the regression results (*f(x)/*A*)* and the $R^2$ value on the log sheet (should be $R^2 > 0.99$).

**P wave calibration - whole core**

- Record the room temperature on the log sheet.
- Ensure the software is set to log as "horizontal" under the "settings" tab.
- Measure internal thickness and external thickness, at multiple points around the liner with callipers.  The liner thickness will vary around the circumference, take an average.
- Create calibration piece from section of liner representative of the core, fill with tap water and seal caps on.
- "Total Thickness (cm)" is the external thickness, core liners are not perfectly manufactured, please take an appropriate average, record on the notes sheet if the core liner is particularly poorly shaped.
- Ensure "Total Liner Thickness (cm)" is recorded (this should be twice the wall thickness).
- "TOT": open "P-Wave travel time" calibration, check the delay and the gate are appropriate for whole cores, place an empty piece of core liner between the P-Wave transducers, record TOT on the calibration spreadsheet. Using the graph below as a guide, set the delay to appear before the start of the signal. The TOT should align one wavelength from the start of the signal, the gate should align with the entire
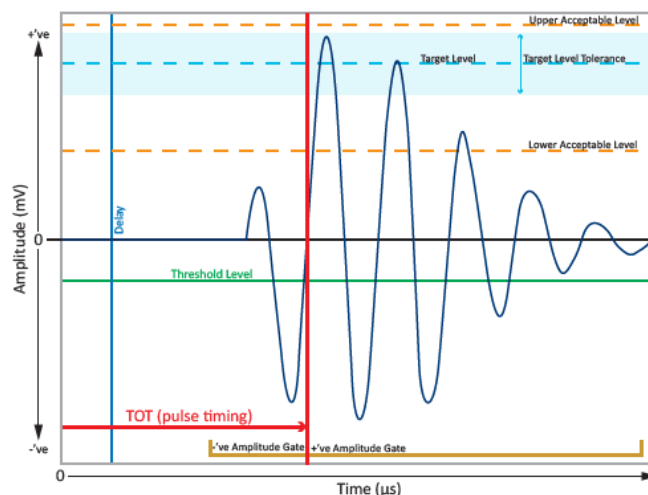
window of sample visible on the oscilloscope.



Figure 6-1. Pulse timing, automatic level settings and amplitude gate.

*From the Geotek MSCL manual online.*

- PTO should be generated, record this value on the log sheet.

**Magnetic Susceptibility**

- Select appropriate diameter sensor for magnetic susceptibility, this should be the smallest diameter loop possible.
- Check serial number of loop and select the corresponding magnetic susceptibility calibration piece.
- Zero in Utilities or on the sensor panel.
- Check that the MS meter is set to CGS for calibration, return to SI for measurement of core
- Measure over the dotted line in the centre of the calibration piece.  The person holding the calibration piece must have it centred in the loop, and ensure no jewellery or metal is nearby the loop.
- Press the "m" button on the Bartington control unit.
- Check value corresponds to the CGS value written on the calibration piece
- Core sections must be central when passing through the loop, position it appropriately and secure.  Adjust the two screws on the loop mount on the MSCL-S and secure loop in place carefully.

**Data Cleaning**

- Core thickness: Delete "all points at selected depth" from core depths where core caps were left on, or there is an irregularity in the liner.
- P-Wave velocity in water is 1482 m/s, therefore this is the minimum value acceptable (consider values as low as 1450 for colder rooms), values can be as high as 2000 m/s. Amplitude values close to 0 should be deleted immediately, this is probably the result of poor contact with the core liner
    - Delete from the P-Wave Amplitude panel instead of the P-Wave velocity panel.
    - Any extreme values at core section breaks should be deleted from either the amplitude or velocity panel.

- o   Any velocity value below from 1450 m/s should be deleted
- Electrical Resistivity: resistivity peaks in a predictable fashion around the ends of each core section, delete all points that appear to show the characteristic increase, then decrease at the end of the sections. This may be up to 7 cm either side of the end of the core liner.
  - o   Resistivity values are typically under 2 for most marine sediments
- Magnetic susceptibility: will vary considerably through the core, any extreme values should be deleted, this is more likely at section breaks. If there is doubt this parameter can be checked by later analysis on the XYZ. All negative values < -60 (minimum for pure Gypsum) should be deleted, any extreme high values are a result of the instrument failing to zero and should be deleted.
  - o   Values are rarely above 400 (volcanic ash horizons or volcanic turbidites can be higher. the academic who has requested this analysis should know if this is the case).
- Density: Should be between 1.2-2.5. If it is substantially above or below (if the sediment core contains peat or sapropel layers, it can be lower, check this with the scientist), check the correct RCT, A, B and C (taking care with positive or negative values for A and B) have been added to the calibration in the software. Manually check the core thicknesses if necessary as this is the most likely option for error.
- P-Wave velocity is calculated from P-Wave travel time and core diameter, and Impedance is calculated from the P-Wave velocity and density, if considerable amplitude values have been deleted, these panels will be empty.

**Final checks**

- Check the calibration has been entered into the MSCL-S processing panel, and check the values are valid (see above).
- At the end of processing and cleaning data, go to file, create ascii file and save from the processed panel (.OUT file).
- Save a record of hidden points (.DEL).
- From the raw data create ascii and save as .RAW.
- Check the folder contains all five data files (CAL, DAT, DEL, OUT AND RAW) and the calibration spreadsheet.
- Check the relevant box of the log sheet to indicate the data has been cleaned and calibrated.

**Tables for representative values**

Check the measured values are in line with the most appropriate deep marine sediment values from the tables below. If you have any concerns, please ask the relevant scientist for information on likely sediment types.

| Sediment type | | Density | Velocity |
|---|---|---|---|
| Sand | Coarse | 2.03 | 1836 |
| | Fine | 1.98 (± 0.024) | 1742 (± 10) |
| | Very Fine | 1.91 | 1711 |
| Silty Sand | | 1.83 (± 0.025) | 1677 (± 9) |

| | | |
|---|---|---|
| Sandy Silt | 1.56 | 1552 |
| Sand-Silt-Clay | 1.58 (± 0.030) | 1578 (± 9) |
| Clayey-Silt | 1.43 (± 0.016) | 1535 (± 3) |
| Silty Clay | 1.43 (± 0.013) | 1519 (± 3) |

| Sediment type | Density | Velocity |
|---|---|---|
| Sandy Silt | 1.65 | 1622 |
| Sand-Silt-Clay | 1.60 | 1634 |
| Clayey-Silt | 1.38 (± 0.029) | 1535 (± 2) |
| Silty Clay | 1.24 (± 0.010) | 1521 (± 2) |
| Clay | 1.26 | 1505 |

| Sediment type | Density | Velocity |
|---|---|---|
| Clayey-Silt | 1.41 | 1531 |
| Silty Clay | 1.37 (± 0.014) | 1507 (± 2) |
| Clay | 1.42 (± 0.023) | 1491 (± 1.4) |

Tables from: Hamilton, E.L. 1970. Sound velocity and related properties of marine sediments, North Pacific. *Journal of Geophysical Research* 75: 4423-4446.

# MSCL-S log sheet

| Operator: | Date: |
|---|---|

| Cruise: | Core(s): |
|---|---|

Sections (number, length and order):

Core labelling order:

| Split/Whole Core | | | |
|---|---|---|---|
| Separator | Yes / No | Average Length (cm) | |

| Temperature (°C) Start of day: | Core liner thickness (cm): | PTO: |
|---|---|---|
| Temperature (°C) end of day: | Weather: | TOT: |
| Total Thickness (cm): | Internal Diameter (cm): | Total Wall Thickness (cm): |

Gamma Calibration – enter thickness in cm

| | Blank | Al 1: | Al 2: | Al 3: | Al 4: | Al 5: |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| Average | | | | | | |

Gamma result

| A = | B = |
|---|---|
| C = | $R^2$ (should be > 0.99) = |

Resistivity Calibration

| Zero Res. | 0.35 g/l (tap) | 1.75 g/l | 3.5 g/l | 8.75 g/l | 17.5 g/l |
|---|---|---|---|---|---|
| | | | | | |

Resistivity result

| A/f(x) = | $R^2$ (should be >0.99) = |
|---|---|

| **Magnetic Susceptibility Calibration** | **Yes/No** |
|---|---|

| Has the calibration information been entered to the MSCL processing software | |
|---|---|
| Has the data been cleaned (Name and date) | |

**Notes:** Please record any issues with sediment core including missing sections, large IRD clasts removed, any change to the order of sections. Make a note of the section numbers that correspond to separators if used.

| Software Section Number | Core Number | Section Number/ total sections | Length | Data cleaned? Y/N |
|---|---|---|---|---|
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