**Appendix A6:  MGL0910 EM122 Multibeam Collection and Processing**

 **B.DATA COLLECTION**

The bathymetric data was collected using R/V Marcus Langseth’s Simrad EM122 12kHz multibeam echo sounder. The vessel entered the survey boundary at 11/20/2015 04:34:34.394 JD 324, 36°.7947N 25°3953E, where the data acquisition commenced.

During the deployment and the recovery of the OBSs the EM 122 was disabled at each site to avoid interference with the acoustic release and ranging of the OBSs. Moreover, after the deployment of W140 and S160 OBSs additional survey lines were conducted on south west side of caldera to determine the appropriate path to enter in order to avoid shallow water area and ensure that the string of guns towed at 12m below the sea surface did not hit the sea bottom.

The EM 122 has a maximum swath width up to 6 times the water depth depending on the sea state. During the first days of the survey, especially when shooting the outer lines (1-4) the data was of very good quality, the center and outermost beams didn’t have significant scatter. The data was of poorest quality when heading into rough seas and the outermost beams had significantly more scatter than the inner ones. The ping mode was set to SHALLOW and the swath angle to 75° (depths < 450m) and then narrowed down to 68° (depths > 450m) to achieve highest possible resolution. During the cruise 28 XBT’s were launched but only the first 19 imported in the SVP editor (except the 15th and 16th that were launched into the Kolumbo and the 17th that malfunctioned). Moreover, on 12/03/2015 at 1:48am the EM 122 crashed for one minute, worthwhile taking into account while processing. After the recovery of the OBSs and multiple attempts to recover OBS 116, additional survey lines were conducted at the southern part of Santorini.

Data was acquired by the EM 122 system into half hour Simrad ".all" files with the filenames ####\_YYYYMMDD\_HHMMSS\_Langseth, where "####" is a sequential file starting with "0000" and ending with "0968".The files were processed with MB-SYSTEM.

1. **PROCESSING PERFORMED AT SEA**

The first step in processing was the definition of a vessel configuration file "langseth.hvf". Because the EM122 system includes corrections for the relative positions of sensors on the boat, the Heave, Pitch, Roll, Gyro and Navigation sensors were assigned coordinates in meters [X(positive to Forward), Y(positive to Standboard), Z(positive Downward)] of [0,0,0] and in degrees [Roll, Pitch , Heading]. The correct values for the Transducer were set to [20.925, 0.570, 8.459] and [0.1603, -0.0772, 359.99]. The correct values for the Receiving transceiver were set to [16.068, 0.050, 8.535] and [0.1603,-0.0772, 0.00] and the Waterline was set to Z=+1.94.

The MB-SYSTEM processing steps applied during the cruise comprised:

**D.GENERATION OF PRELIMINARY ".grd" Grid and GMT Maps**

MB-SYSTEM is an open source software package for the processing and display of bathymetry and backscatter imaginary data. Some pre-processing steps are required before the bathymetric data can be processed using MB-System. Firstly the vendor format should be recognised. The onboard *RV MARCUS LANGSETH* hull-mounted Kongsberg EM122 uses the format ID 58, whereas the format 59 is needed for further processing with MB-System.

Every raw file was converted as followed:

* + - 1. **Converting the data**
* Extract file names and use it for output

 #file name is /data/CruiseData/MGL1521/raw/multibeam/MGL1521/2015/11/23/0195\_20151123\_233959\_Langseth.all

 # sed replaces the \_ by spaces

 # awk combines words 2 and 3 (20151123 and 233959)

set file59 = `echo $file | sed s/\_/" "/g | awk '{print $2$3}'`

* Convert the raw file to the required format

mbcopy -I file -F58/59 -O output.mb59 (This works for one file for an entire datalist use mbm\_copy)

-F58/59 means convert form raw format mb58 to mb59

-O is for the name of the output file

* + - 1. **Cleaning the data**
* Create a list of all the files

ls \*.mb59 > files.mb59

mbclean -C60/2 –S60/3/2 -I files.mb59 -F-1 –M2

-C defines the maximum slope accepted between beams -2 is the unit (1 = radian; 2 = degrees) -60/2 means 60 degrees

-S defines what qualifies as spikes -same convention as C the unit (1 = radian; 2 = degrees) -60/3/2 means 60 degrees and that spikes can be identified in both directions (3), across track and along track.

-F format – negative value means list of files

-G can be used to flag data where depth is different from median beam –G0.8/1.2 will limit beams with depth between 0.8x median\_beam and 1.2xmedian\_beam

* + - 1. **mbprocess to clean the data flagged by mbclean**
* Generates files with the same name and a p before the extension (processed) (i.e. p.mb59)

mbprocess –I files.mb59 -V -P

 -I defines the input list

 -V when added the program works in a "verbose" mode and outputs the used program

 Version

 -P every file will be processed

* + - 1. **Generate Grid File**
* First create the list with the processed files

Sed s/.mb59/p.mb59/g files.mb59 > processed\_files.mb59

mbgrid –A2 –I processed\_files.mb59 –E50/50 –O grid1 –N

-A2 means bathymetry data are given negative values

-O is for the name of the output file

-E50/50 is the grid size cell

-N is to ensure that missing data are filled with NaN to be ignored

* To generate the grid for the raw data

mbgrid –A2 –I files.mb59 -E50/50 -O files\_raw.grd -N -R25.9/26.1/36.7/36.8

-R defines the limits, which is necessary for the "raw"

This command creates a .cmd file and when executed produces a postscript showing a preliminary plot of the grid file.

 Every produced grid was checked and several files were further processed as followed:

* **Create a list:** ls \*p.mb59 > datalist\_p59 containing all the files that need more detailed processing
* **Create the ancillary files:** mbdatalist -F-1 -I datalist\_p59 -V –N

-F format –negative values means list of files

-I Input list of files

-N generates the three ancillary files (\*inf; \*fbt; \*fnv)

-V when added the program works in a "verbose" mode and outputs the used program version

* **Examination of data points and flagging:** mbedit, mbeditviz
* **Process the data:** mbprocess -I datalist\_p59 –V –P

-I defines the input list

-V when added the program works in a "verbose" mode and outputs the used program version

-P every file will be processed

mbprocess will generate files with the same name and a second p before the extension meaning that the file was twice processed.

* **Create a new list:** ls \*pp.mb59 > datalist\_pp59

**Generate Grid:** mbgrid –A2 –I datalist\_pp59 –E50/50 –O grid1 –N

-A2 means bathymetry data are given negative values

-O is for the name of the output file

-E50/50 is the grid size cell

-N is to ensure that missing data are filled with the NaN to be ignored

**NOTE:** Due to the abrupt changes in the seafloor morphology (basins, volcanic edifices, fault zones) the command mbclean sometimes flagged correct beams. It is recommended to get a first impression of the dataset by generating a plot.

mbm\_plot -F-1 –I datalist –G2 –N –PA4

-F format –negative values means list of files

-G2 colour fill swath plot is turned on and the style of the plot is defined, different modes. In this case Mode 2 = colour shaded relief bathymetry, Mode 1 = colour fill of bathymetry data

-N causes a navigation track plot

-PA4 page size A4

  **E.MB-System Processing not Performed at Sea**

MB-System can be used for additional processing.

**1.**Interactive Flagging of Bathymetry using *mbeditviz and mbedit*

**2.**Generate grids (*mbgrid)* using thin plate spline interpolation and choosing between the available gridding algorithms.

**3.**Export the acoustic backscatter and the sidescan sonar data for further analysis.

**F. Outstanding Questions/Tasks**

**1.** Verify that the Vessel Configuration is correct

**2.** Ensure that there are not systematic spatial or temporal changes in the water column velocity. Reprocessing using mbvelocitytool.

**3.** Additional processing as mentioned above.