GEOPHYSICS PROCEDURES (VERSION 1.107)

DIGITAL ARHIVISTS
ARCHAEOLOGY DATA SERVICE
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1. Purpose of this document

1.0.1 This documents current ADS procedures for production of dissemination and preservation copies of geophysical data. It contains a list of current dissemination and preservation formats and how to migrate files to required formats. More information on this data type, can be found in the G2GP for Geophysics http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc.

1.0.2 More than any other datatype it is important to receive the data in the specified formats. Over the last 5 years we've spent a lot of time in trying to convert proprietary data to 'preservation formats', but this process is fraught with pitfalls (see further discussion below).

2. Formats[1]

2.0.1 Geophysics data can come in a myriad of formats, however we should insist on the receiving the following so as to keep any file transfers to an absolute minimum. The G2GP has a good discussion on Geophysics formats by Armin Schmitt.[2]

Offered format	Accepted	Preservation	Presentation	Notes
Raw xyz data: **.txt/ .csv/ .asc** Contors: **.dat/ .rep**	YES	Comma Separated Value **.csv** Contors: **.dat/ .rep**	Comma Separated Value **.csv** Contors: **.dat/ .rep** For groups of files, or where files are over	Resistivity/ magnetometry[3] Contors[4]

[1] Most programmes designed to handle geophysical data can export the data in xyz format. Depositors should use this facility and to supply copies of the data in this format.
[2] http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_App1.
[3] XYZ text files could more appropriately be called 'XYV text files'. These are text files (usually only using ASCII coding) in which each text line contains the values of the coordinates (X and Y) as well as a measurement value. As these files were initially used with topographic heights as the measurement value ('Z') they became known as XYZ text files but any other data value could be used ('V'). The three values can either be separated by blanks, tabs or commas. If commas are used as separators the file format is often referred to as csv, meaning 'comma separated values'. It can be useful to add a header line to a XYZ text file that contains the names of the columns represented in subsequent lines (e.g. "X, Y, MagField").
[4] Contors is a DOS programme written by John Haigh of the School of Computing and Mathematics, University of Bradford, for viewing geophysical data. The data are held in (*.dat) files which are comma delimited ASCII files with 20 lines of data each holding 20 floating point numbers. Sets of *.dat files hold contiguous blocks of data and their spatial relationships are defined in .rep files.

			50MB, **.zip** archives of the formats listed above should be used for dissemination.	
SEG-Y Rev.1 **.segy**	YES	SEG-Y Rev.1 **.segy**	SEG-Y Rev.1 **.segy** For groups of files, or where files are over 50MB, **.zip**.	GPR[5]
Text file (AMNBV format, see below) **.txt**	YES	Text file **.txt**	Text file **.txt** For groups of files, or where files are over 50MB, **.zip**.	Geophysics type: ERI files.
Raw xyz data: **.txt/ .csv**	YES	Raw xyz data: **.txt/ .csv**	Raw xyz data: **.txt/ .csv** For groups of files, or where files are over 50MB, **.zip**.	Geophysics type: Other (includes Alkali vapour, pulse induction)
Rendered images: **.png** or **.tif**, sometimes with assoc.	YES	Rendered images: **.tif** (+ **.tfw**)	Rendered images: **.tif** (+ **.tfw**) or **.png** (+ **.pgw**)	**For Documentation only**: **NB** best to disseminate in the same format as they were received in

[5] The Society of Exploration Geophysicists publishes SEG Y format. It is an openly published binary data format for storing raw GPR data. SEG Y was originally developed in 1973 but was revised in 2002. The spec is attached as a pdf. There are a number of free viewers for SEG Y data files. These include GSEGYView 0.2, SeisVU and the SEGY Viewer by PETRA. This format is ideally suited for dissemination. It is strongly recommended to export GPR data to the seismic 'SEG-Y (revision 1)' format as defined by the Society for Exploration Geophysicists. Most GPR packages allow export of their proprietary data to SEG-Y, although not all seem to fully adhere to the SEG-Y standard so it may be best to check the output with one of the free SEG-Y readers available online (e.g. SeiSee, SeiView, SEGYViewer, GSEGYView).

world file **.pgw** or **.tfw**				
Geoplot Grid Files **.dat, .grd, .grs, .hdr**	NO			Geoplot makes use of a selection of proprietary file formats. As some of these elements are binary, we advise that the depositor export the raw xyz data into comma separated values format (.csv or .txt). Also, the creation of raster images for presentation purposes is recommended (.tif, .png). Both of these can be generated with relative ease by using the Geoplot software.
Geoplot Plotmesh file **.plm**	NO			Master grid/mesh file, ASCII text but only of use with the geoplot grid files. This information should be documented elsewhere if depositing raw text files.
Other Geoplot Files **.sta, .his, .tem, .gip, .cip**	NO			
Geoplot Composite Files **.cmp, .cmd, .cms**	NO			Geoplot Grid files merged into a single composite. These *can* be the raw data but obviously make certain reprocessing (e.g. edge matching) difficult as would need to be broken back down into grids. Not recommended but OK (raw data) if there's nothing else.

GPR (other) **.rd3 + .rad + .grd**	NO			Processed MALA RD3 files,
GPR (other) **.rd3 + .rad + .mrk + .cor + .obm**	NO			Original MALA RD3 files
GPR (other) **.dat + .par**	NO			Raw output from ReflexW software
GPR (other) **##R + ##T** e.g. 12R + 12T	NO			Processed output from ReflexW software
Surfer data files **.grd**	NO			Surfer is a general purpose mapping programme. Data files may be ASCII or binary. The ASCII version is suitable for archiving.
InSite data files **.dat, .lst**	NO			Acceptable format, although some elements are binary.
Sensys Magnetometer files **.dgb, .disp, .prm**	NO			Can be exported to ASCII CSV.
GSSI Radan files **.dzt**	NO			

3. Documentation / Metadata

3.0.1 Alongside the standard metadata for files, the following additional documentation is required for any database. The current metadata template is available from the Guidelines for Depositors.[6]

[6] https://archaeologydataservice.ac.uk/advice/guidelinesForDepositors.xhtml.

Element	Description
All Survey Types	
Survey Name	If your survey has an alternative title to the one provided during the creation of the project metadata, you can add it here
Survey Index	Here you should add the identification number or code used internally for the survey and any related data
Description	Provide a brief description of the geophysical survey
Survey Purpose	Brief description of the purpose of the geophysical survey
Location	Provide a list of locational terms for the geophysical survey
Locational Coordinates/Extent	Provide locational grid references for the geophysical survey
Survey Duration	Start and end date for the survey
Survey by	The person and/or organisation responsible for carrying out the survey
Copyright holder	Copyright holder for the survey
Solid Geology	Record the base geology for the location where the survey was carried out
Drift Geology	Provide the overlying drift geology for the place where the survey
Land Use	Provide the prevailing land use for the area being surveyed
Survey Type	The technique used to carry out the survey
Instrumentation	Include specific information about the type and configuration of the equipment used during the survey
Area Surveyed	The area of ground covered during the survey
Method of Coverage	Here you should indicate how the survey area was covered and the data acquired: gridded data; line data; non-gridded data; scanning
Traverse Separation	The distance between each survey traverse

Reading Interval	The distance between each reading a long a traverse
Sampling Position	The exact location where data was recorded whether within the grid squares or at grid corners
Line Sequence	Used to record the way in which the grid was walked, typically this can be in parallel lines always in the same direction (uni-directional), or back and forth (zigzag/ bi-directional)
Resolution	Used to record the spacing between each data point across the x and y axis.
Survey Direction	Add the direction in which the first traverse was carried out and where subsequent traverses were located
Description of File Formats	Any additional information about the file formats your survey utilises
Additional Remarks	Additional remarks that may be important to the reuse the data
Language	The language(s) used within the drawing or graphic
Filenames	List the file names relating to this metadata
Grid size	When data has been collected using data grids, the size of overall grid must be documented to allow for the correct computation of the data outputs
Electro-magnetic	
Coil Configuration	This field should be used to record the distance of the coils within the instrument used for the electromagnetic survey
Recorded Component	The recorded electromagnetic component needs to be specified
Ground Penetrating Radar	
Antenna Information	For those surveys using pulse radar systems you should record the centre frequency of the antenna
Time Delay	The time delay for the recording of the first reflection expressed in seconds
Time Sampling Resolution	The resolution of the time sampling expressed in seconds

Time Span	The maximum time span of the recording expressed in seconds
Average subsurface velocity	Provide an estimate of the electromagnetic velocity in order allow the conversion of two way travel times to depth
Average subsurface note	Average Subsurface Velocity should be accompanied by a statement/note about how it was derived
Magnetometer	
Magnetic north	For magnetometer surveys it is important to provide the orientation of the coordinate system/grid in relation to Magnetic North
Instrument drift	During any survey the magnetometer may exhibit evidence of a gradual change in its readings
Resistance	
Electrode configuration	Any responses from below ground features are heavily influenced by the configuration of electrodes used
Electrode spacing	To process the data collected during a survey it is essential that the distance between electrodes is recorded
Multiple configurations	Earth resistance data can be recorded at each measurement location using different electrode configurations by means of a multiplexer
Maritime Sonar	
Average water velocity	The average water velocity during the survey in m/s
Sonar frequency	The frequency of the sonar in kHz
Beam width at nadir	An estimate of the beam width gap in degrees at nadir
Supporting Documentation	
Geo-rectified Tiff	geo-rectified TIFF of high quality and a pre-processed composite file(s) of raw data. Where possible this should include dedicated GIS metadata
Supporting documentation	any additional information

4. Accessioning checks

4.1 Checks

- Data is in the correct format (see table below). This is perhaps more important for Geophysics than any other datatype as we have almost no effective software to check content (see below).
- Metadata is present. Again, very important for reuse of this particular data type.
- Secondary data (Exported/derived data): it is common for data to either be exported or derived from the geophysics plot - for example image overlays (vector or raster) or images exported as georectified images for use within a GIS. Although associated with the dataset, these are not (unless specifically stated) the 'geophysics data'. Any use as documentation or metadata should be clearly identified as such by the depositor (for example a raster image with the survey site grid, text file of notes and so on). Otherwise, we should deal with the secondary data according to the appropriate procedures document.
- Exported images are used frequently in geophysics, often it is a convenient way to record survey grid layout as documentation for the raw data. Images should be clearly identified as such, and should be dealt with according to conversion/storage guidelines below. In conversations with geophysicists, it seems that they despise JPG for any kind of export of a data plot - bear this in mind!

4.2 Significant properties

4.2.1 Geophysics data comprises a given value for a specific geographic point (or cell), often just based on a local rather than national grid or UTM (although some instruments record geographic referencing in the data).

- The cell/point/scan values
- Technical details for the values (includes collection strategy, technical parameters included within metadata)
- Relationship to other files in the archive - for example a survey may comprise multiple files
- Geo-referencing (if present). Note: a file should not rely on a shapefile for geo-referencing. The extents of any survey should be included in the accompanying metadata.

As highlighted several times in the G2GP, migration of proprietary to preservation formats often involves the loss of metadata (often stored in headers and such). It is therefore paramount that metadata is present, accurate and stored with the data.

4.3 File-naming

4.3.1 Where possible files should retain the same name as the original. On occasion (and normally for dissemination), it may be necessary to create different versions of the same file. In these cases a logical naming strategy should be used, and should be accompanied by explanation in the Processes section of the CMS.

4.3.2 All files and metadata should be placed in the appropriate location as outlined below.

5 How to convert files

We should not need to convert geophysics data files. Documentation (text and images) should be dealt with according to the relevant procedures document. However, they should be stored as documentation as per procedures below.

6. Storage

6.1 Storing data

6.1.1 Data should be stored in appropriately named folders, as described in the ADS Repository Operations manual.[7] Any directory structure from the SIP should be retained in the AIP. In some cases editing/restructuring may be necessary, but such restructuring should be recorded in the Processes section of the CMS.

6.1.2 On occasion, and because of the large number of composite files created by a survey, the dissemination versions will need to be zipped up. In this case disseminate in a sensible, logical fashion under their original file extension.

6.1.3 Otherwise, store data in one of the following directory structure:

/preservation
    /{original_structure}
        geophys_raw_data1.csv
        geophys_raw_data2.csv
        geophys_raw_data3.csv
        geophys_raw_data_rendered_image.tif
        geophys_raw_data_rendered_image.tfw

/preservation
    /{original_structure}
        gpr_raw_data1.segy

[7] https://archaeologydataservice.ac.uk/advice/PolicyDocuments.xhtml#RepOp.

6.1.4 In cases where gridded data is supplied (contrary to the current Guidelines for Depositors these often replicate filenames, so should be stored in requisite folders for each 'area' surveyed./{original_structure}

/preservation
/{original_structure}
/Area1
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
geophys_raw_data_rendered_image.tif
geophys_raw_data_rendered_image.tfw
/Area2
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
geophys_raw_data_rendered_image.tif
geophys_raw_data_rendered_image.tfw

6.1.5 Dissemination

/dissemination
/{original_structure}
geophys_raw_data.zip
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
geophys_raw_data_rendered_image.zip
geophys_raw_data_rendered_image.jpg
geophys_raw_data_rendered_image.jpw

/dissemination
/{original_structure}
gpr_raw_data1.segy

6.1.6 In cases where gridded data is supplied (contrary to the current Guidelines for Depositors these often replicate filenames, so should be stored in requisite folders for each 'area' surveyed.

/preservation
/{original_structure}
/Area1
/geophys_raw_data_Area1.zip
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv

/geophys_raw_data_rendered_image_Area1.zip
geophys_raw_data_rendered_image.jpg
geophys_raw_data_rendered_image.jpw

/Area2
/geophys_raw_data_Area2.zip
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
/geophys_raw_data_rendered_image_Area2.zip
geophys_raw_data_rendered_image.jpg
geophys_raw_data_rendered_image.jpw

6.2 Storing metadata

6.2.1 File and metadata should be stored in an appropriate archival format with the preservation/dissemination files in a "documentation" folder within the requisite folder, for example:

/preservation/
/{original_structure}
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
/documentation
geophys_raw_data_metadata.csv

/dissemination
/{original_structure}
/geophys_raw_data.zip
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
/geophys_raw_data_rendered_image.zip
geophys_raw_data_rendered_image.jpg
geophys_raw_data_rendered_image.jpw
/documentation
geophys_raw_data_metadata.csv

6.2.2 **All** geophysical data should be accompanied by an appropriate geo-rectified image (TIF). Unlike other forms of documentation, these files are treated as data and NOT documentation. This identification extends to the OMS where such files are classified GIS rather than Geophysics. Similarly, these files should be treated as data and stored alongside the other data, and not within a dedicated documentation folder.

/preservation

/{original_structure}
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
geophys_raw_data_rendered_image.tif
geophys_raw_data_rendered_image.tfw

/dissemination
/{original_structure}
/geophys_raw_data.zip/
geophys_raw_data1.csv
geophys_raw_data2.csv
geophys_raw_data3.csv
/geophys_raw_data_rendered_image.zip
geophys_raw_data_rendered_image.jpg
geophys_raw_data_rendered_image.jpw

6.2.3 In some cases, documentation can be split to accompany specific/relevant parts of the archive (i.e. it does not all need to go in one folder), for example:

/preservation
/{original_structure}
/radar_survey_05
radar_survey_05.csv
/documentation
radar_survey_05_metadata.csv
/radar_survey_06
radar_survey_06.csv
/documentation
radar_survey_06_metadata.csv

7. Creating and linking objects in the OMS tables

7.0.1 See Match Objects Overview for general overview {internal access only}
see also CMS-OMS TableStructure for MOS data requirements {internal access only}

8. Tech watch / things to note

9. Archival notes

10. References