



Preservation Handbook

Geophysics

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Definition

Geophysical survey

Geophysical survey is a prospecting technique that exploits a variety of physical characteristics of rocks and soils etc, in an attempt to locate underground features of potential interest. All geophysical survey data are digital and, with current data storage technologies, are often stored immediately in digital form by the recording instrument to be later downloaded to a computer, although some instruments may be connected directly to a computer which uses proprietary software to receive and store the recorded data.

The main users of geophysical techniques are mineral prospectors. Archaeological and forensic uses of geophysics differ from mineral prospecting in dealing with far shallower deposits and thus generally using more subtle techniques. As such they can be considered to constitute a separate branch of the discipline.

Airborne and space-borne imagery are frequently classed as geophysical survey. These result in bitmap images and associated metadata, normally in the form of text files. See the Bitmap (raster) images and Plain text Preservation handbooks for details on dealing with these formats.

Geophysical data

Archaeological geophysical data are normally in the form of xyz values, i.e. a coordinate value defining a point in a local coordinate grid and a reading from the survey instrument for that point. In many cases the survey is assumed to consist of regular samples taken at standard intervals within a standard survey grid and the xy coordinates are not stored as part of the data. A complete survey generally consists of a set of contiguous survey grids, each stored as a separate data block or computer file. A large survey may result in more than 100 data files.

The physical characteristics of soils and rocks vary according to local conditions and these are an important element of the survey, particularly if a survey is conducted over an extended period of time. Temperature, soil moisture content, the local magnetic environment etc. may have a significant influence over the survey results and should be recorded, where appropriate, as part of the survey data.

Because geophysical data are collected by a dedicated instrument and are normally stored in an integral data logger the raw data is not normally in a recognisable file structure. The data must be downloaded to a computer and stored in a file that will be formatted according to the abilities of the programme controlling the download. Thus it may be in a proprietary, possibly binary, format or a more general format such as delimited text. Data usually have associated metadata either as a file header or a separate file describing the relationships between the data blocks and, sometimes, information about the survey, surveyor, and conditions.

The geophysical data must be accompanied by ancillary data describing at least the location of the survey if this is not stored in the recording/logging machine.

Additional Information

- Geophysical Data in Archaeology: *A Guide to Good Practice*
< <http://ads.ahds.ac.uk/project/goodguides/geophys/> > Last checked 23/02/2005
- Wynn, J.C. A Review of Geophysical Methods Used in Archaeology
< <http://www.terraplus.com/papers/wynn.htm> > Last checked 23/02/2005



Technical Environment

Geophysics data files require processing for their 'meaning' to become apparent. This usually involves creating a greyscale raster image for which the instrument readings are used to generate pixel values giving, in effect, a relief map but the readings can equally be used to create conventional contour plots. Because data are captured at a generally small number of discrete points within the survey area the software will normally need to extrapolate the data to create a complete image. Special purpose software is used to perform this manipulation and also to provides functions to 'balance' different portions of a survey to account for differences in susceptibilities of the ground at different points or different times. Such software is predominantly available for MS Windows platforms.

Most programmes designed to handle geophysical data can export the data in xyz coordinate format and depositors should use this facility to supply copies of the data in this format.

Common Formats

Format	File Extension	Notes
Geoplot data files	.dat, .grd, .grs, .sta, .his, .plm, .tem, .cmp, .cmd, .cms, .gip, .cip	Acceptable format, although some elements are binary.
InSite data files	.dat, .lst	Acceptable format, although some elements are binary.
Contors data files	.rep, .dat	Acceptable format
plain text (xyz)	.txt	Required format
Surfer data files	.grd,	Surfer is a general purpose mapping programme. Data files may be ASCII or binary. The ASCII version is suitable for archiving.



Ingest Checklist

Level 1 (Essential)

- Name of the site, project or survey
- Purpose of Survey
- Spatial Coverage
- District/County/Unitary Authority in which the survey area lies
- Country
- Dates that the fieldwork took place
- Relationships between grids/transects making up the survey
- Direction of travel for each pass on the grid
- Sampling interval within the grids/transects
- Copies of data in proprietary format and as ASCII xyz coordinate data
- Survey instrument details
- Instrument settings (e.g. wavelengths used for Ground Penetrating Radar)
- Details of organisation holding the primary data
- Copies of digital images and texts resulting from the data analysis

Level 2 (Preferred)

- Specification of relative locations of survey grids
- Soil conditions during survey
- Land use of survey area
- Classification of any monument(s) at the site
- Period of any monument(s) at the site
- Surveyor's name and details
- Client details
- Depositor's details
- Identification number/code used internally for the survey event
- Relevant bibliographic information about the site or project
- Underlying solid geology
- Drift geology for the survey area
- Weather conditions during survey
- Schedule Ancient Monument Number(s) for any monument(s) at the site

Location of any related archives

Level 3 (Best Practice)

- Images detailing location, orientation, grids, etc. of the survey

Inform Depositor

- Undocumented (proprietary) ancillary binary data will not be preserved.
- Any data for which the depositor does not hold copyright will be removed.



Preservation

Significant Characteristics

The key significant values are the geographical location of the survey, the relationship between the local (survey) and national or international grids, and the point locations and level readings collected during the survey. Additional important data are those factors that may influence the readings recorded by the instrument, such as local geology and weather conditions particularly, for the later, if they changed substantially during the course of the survey.

The details of the survey instrument and its settings are important, as these will also significantly affect the data. Thus the wavelengths used in ground penetrating radar must be recorded as part of the survey data.

Technique

Export data to delimited text file as xyz data and create metadata describing the contents, i.e. how the data is laid out in the file, the scale of the spatial co-ordinates, and the units and scale of the z value.

Ensure that multiple data files for a single survey can be correctly assembled by storing metadata detailing their relative positions, orientations and the directions of traverses within each survey unit relative to the site grid or, if possible, the national or international grid.

Store any data which may assist in balancing the constituent parts of the survey, i.e. the local factors that can influence the response of the measuring instrument (soil moisture, temperature, etc.) and associate these data with the particular data files to which they apply.

Store the relationship between the site grid and the national or international grid.

Check any accompanying digital images for embedded material for which the depositor does not hold copyright, e.g. vector map data. All layers within CAD files must be examined to ensure they do not contain such material in hidden layers.

Prepare preservation versions of accompanying text and image files according to the guidelines to be found in the Bitmap (raster) images, CAD, Vector graphics, Binary Text/Word processor documents Preservation Manuals.

Validation of Exported Data

XYZ coordinate data should be checked to ensure that the contents are numeric, i.e. that only valid numeric characters (including sign and decimal separator) are present along with delimiters and white space characters. Validate other elements according to the recommendations in the Bitmap (raster) images, CAD, Vector graphics, Binary Text/Word processor documents Preservation Manuals.

Problems and Issues

All geophysical survey files are legacy, designed to be analysed by the software package associated with the instrument. As such they should all be treated as binary files because the format may change with updated software versions. Although ASCII xyz coordinate files can be created from the data in many cases these will not contain all the information. Currently the situation is poor. To preserve the data the original files need to be preserved. However there is little documentation of the content, format and encoding of these files, without which they are of very limited value.

There are further problems regarding the storage of the data files. These tend to be held in specific directories according to the purpose of the file, for example Geoplot stores raw data, the initial processed data (detailing how the elements of the survey are to be laid out on a map) and composite data (all initial and processed data compiled together in a big block) in separate directories.

Depositors may not be aware of the locations of all the relevant data files on their computers and may, as a result, only submit a part of data.



Additional Information