DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 1998/107

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F. Schjøth and L. Thorning

(1 CD-ROM included)

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Contents

Abstract

This report contains a CD-ROM with a digital version of the Thematic Map Series Grønlands Geologiske Undersøgelse 96/1 published as paper maps with a general description in 1996. The maps and the digital data are made available here as an ArcView GIS project file customised to the Thematic Map Series product. The digital GIS data are provided as shape files, grid files and image files with associated data files. The digital GIS data are positioned in either geographic decimal degrees or in UTM co-ordinates Zone 20. The best view-projection is UTM Zone 20.

This CD-ROM is for users who have an ArcView GIS software licence and a basic knowledge of the ArcView GIS software. The freeware ESRI ArcExplorer (version 1.1.2) is not a suitable viewer for the digital GIS data due to lack of projection facilities in the program.

An Acrobat Reader version of the Thematic Map Series Grønlands Geologiske Undersøgelse 96/1 is also included on the CD-ROM.

The printed part of the report contains background information and a brief summary of the experience gained in the process of producing an entirely digital version of the maps.

The major part of the work was carried out as part of a project financed by the Government of Greenland (Bureau of Minerals and Petroleum, formerly the Minerals Office). The concepts and techniques developed during this project have been integrated into the information system GimmeX (Geoscience Information Management for Mineral Exploration in Greenland) and will be used for future GIS compilations of geodata from Greenland.

The report contains no new geoscientific information on Inglefield Land.

Introduction

The Department of Economic Geology of the Geological Survey of Denmark and Greenland (GEUS) has worked towards a digital mode of operation for some years. Since the first collection of thematic maps (Steenfelt *et al.* 1990; Thorning *et al.* 1994) was prepared using graphical software mainly intended for layout, the spatial aspect of the data and the maps have gradually become more important (Ady & Tukiainen 1994). The digital basis for the maps from Inglefield Land (Schjøth *et al.* 1996) included topology and links to databases prepared entirely from digital data, although the maps were published on paper. This was achieved using ARC/INFO (Unix ver. 7.0.4 and 7.1) and ArcView GIS (Unix and PC ver. 2.1a and 3.0a,b), both ESRI GIS-products (GIS = Geographic Information System). The move to a combination of ARC/INFO and Ingres relational database management systems (RDBMS) was initiated with the preceding issue of the Thematic Map Series (Ady & Tukiainen 1994; see also Ady 1995). The full integration of ARC/INFO, ArcView GIS and Ingres is now implemented in the Department of Economic Geology. In Schjøth *et al.* (1996) it was announced that a digital version of the maps from Inglefield Land was forthcoming. Both goals have been achieved with this CD-ROM version of the maps released with this report. In addition, the production of the data as a prototype of a CD-ROM GIS compilation has added significantly to the development of the integrated system of the Geoscience Information Management for Mineral EXploration in Greenland (GimmeX).

This report does not provide new geoscience information on Inglefield Land. Since the compilation of the thematic maps (Schjøth *et al.* 1996), a few reports have become available (Corbett 1995; Coppard 1996; Gowen & Kelly 1996; Appel 1997), but the results have not been incorporated into this report. This report deals more with the technique placing GIS data on a CD-ROM rather than geoscientific interpretation. In order to provide easy access to the original publication of the thematic maps from Inglefield Land, a slightly modified Acrobat Reader (ver. 3.0) version of Schjøth *et al.* (1996) has been added to the CD-ROM. It includes links to PDF versions of all the 51 thematic maps from Inglefield Land. The Acrobat Reader software (English version) is also provided on the CD for installation by the user but it can also be accessed from the Internet (at http://www.adobe.com).

This report is designed to provide geoscientific background information of Inglefield Land on the CD-ROM. For users of the ArcView GIS software the CD-ROM is largely self-explanatory and can be used as soon as a few basic parameters are understood. Thus the report contains much of the necessary information simply as attached figures and tables.

The GIS data provided on the CD-ROM are topographic, Landsat TM, geological, geophysical, geochemical and mineral occurrence data compiled from Survey field seasons 1994 and 1995. The GIS data are positioned in decimal degrees of latitude and longitude with Datum WGS84 (except for grids which, for technical reasons, are in UTM co-ordinates Zone 20, Datum WGS84) and are available in ArcView GIS formats (version 2.1a or 3.0a,b). ArcView GIS project files for both versions are provided on the CD. The project file provides data access mechanisms that greatly enhance the functionality of the system and their use is recommended. Users must provide their own ArcView GIS licence software.

Project aims

Over the past few years the Department of Economic Geology at GEUS has produced four sets of thematic maps from various regions in Greenland in a project financed jointly by the Survey and the Mineral Resources Administration for Greenland (Steenfelt *et al.* 1990; Thorning *et al.* 1994; Ady & Tukiainen 1994; Schjøth *et al.* 1996). Following this, the project 'GIS Compilation of Geoscience Data from Greenland', financed by GEUS and the Bureau of Minerals and Petroleum (BMP), Nuuk, Greenland (formerly the Minerals Office) endeavoured to replace the paper version of the thematic maps with digital publications on CD-ROM. The latest set of maps from Inglefield Land (Schjøth *et al.* 1996) has been used as the prototype.

The original paper publication was prepared and printed with the use of digital media, a word-processor for the text and a GIS desktop-program for the spatial data part. The idea was to make the text and the maps available on a CD-ROM which can be accessed with common desktop GIS software. The results of the pilot project will form the basis for other similar editions based on data from other areas.

Most of the work related to the production of the Inglefield Land CD-ROM is part of a project on GIS Compilation of Geoscience Data and forms an integral part of the development of the GimmeX system in the Department of Economic Geology. The project also contributes to the regional resource evaluation projects in the department. The Government of Greenland (BMP) has financed most of the activities of the project, as part of a general strategy to support developments towards full digital accessibility of all geoscience data from Greenland, as an improved service for exploration companies. The project builds on the experiences gained in the Thematic Map Series project and has the following main goals:

- Digital compilation of data from Inglefield Land and testing of GIS display of the data, as a prototype for additional regional overviews of other areas
- Development of general and specific strategies for digital compilation of data
- Implementation of developed and accepted standards and tools in GimmeX

Choice of software

Since the publication of the first issue of the Thematic Map Series Grønlands Geologiske Undersøgelse in 1990, emphasis has been placed on processing the digital data behind the maps. The maps have been considered as one out of many possible selections and presentations of the basic data. The early issues of the Thematic Map Series were prepared with 'in-house' graphical software intended mainly for layout. Since then the spatial aspect of the data and the maps have gradually become more important. Today the commercial GIS software solves many of the demands of handling spatial data in many phases of the activities in the Department of Economic Geology, as in most exploration companies. The use of commercial GIS software rather than self-developed software has at least two advantages:

- The development, support and updates of the GIS software are carried out by a professional company and do not demand 'in-house' resources

- The use of macro facilitates minor adjustments to the design of the required maps on screen

The Department of Economic Geology uses the commercial GIS software ARC/INFO and ArcView GIS, both ESRI-products (ESRI = Environmental Systems Research Institute, Inc). The move to a combination of ARC/INFO and Ingres relational database management system (RDBMS) was initiated for the production of the Ady & Tukiainen (1994) Thematic Map Series and some of the arguments for this were discussed by Ady (1995). In the course of the project described here, the desktop program ArcView GIS has been added, and the work is now based on a combination of ARC/INFO, ArcView GIS and Ingres. The GIS software versions utilised to process the data for the CD-ROM are ARC/INFO version 7.0.4 to 7.1 running on a Digital UNIX Workstation and ArcView GIS version 2.1a to 3.0a running on a PC (ArcView GIS version 3.0b running on a Digital UNIX Workstation). The access tool to the CD-ROM is intended to be ArcView GIS versions 2.1a, 3.0a and 3.0b available both on PCs and on UNIX with the system requirement described in the chapter 'Use of the CD-ROM'.

The program Adobe Acrobat version 3.0 has some interesting facilities which can bring the output from the GIS software into a form that can be opened by graphical programs such as Adobe Illustrator version 7.0 on PCs. Some comments on the facilities of Adobe Acrobat are included later in this report.

Principles of data structure

The GIS data in this publication come from various sources such as GEUS' photogrammetric laboratory, Landsat TM images, scanned stratigraphic sections, GXF grid files (Grid eXchange File is a standard ASCII file format for exchanging gridded data among different software systems), point databases, attribute databases, etc. The original plan was to bring all spatial GIS data into ARC/INFO formats (on the UNIX platform) and later use the desktop program ArcView (on a PC platform) to access and display the data. This plan was slightly modified in the course of the project to utilise the facilities and flexibility of the fast developing software ArcView GIS. In the revised plan the ARC/INFO formats are converted to ArcView GIS shape files. The ARC/INFO is still used for building, editing, coding of features, the maintenance phase of the basic topographical data, Landsat TM images, the geological data, the geophysical data, etc., followed by the use of ArcView GIS to access the ARC/INFO formats (covers/layers) on the UNIX platform and their conversion to ArcView GIS shape files on the PC platform. The shape files are then customised for the new items/fields with the addition of explanatory text and the removal of unnecessary ARC/INFO information. Finally, a customised ArcView GIS project file for the GIS data is created and transferred to the CD. A shape file added to a view in ArcView GIS is called a theme, but cover, layer or GIS layer are used interchangeably.

Features in each ARC/INFO layer (point, line or polygon layer) have been separated and coded separately by integers after an internal standard used by the Department of Economic Geology. In ArcView GIS the polygon layer can be overlain by the line layer to enhance the visual display of the GIS features. To distinguish the line and the polygon shape files or themes from each other the shape file names is suffixed by _l or _p, respectively.

It is important to keep track of the projection of the original GIS input data and transform it to the projection desired on the CD-ROM. Most of the original GIS data come in the standard UTM projection (Universal Transverse Mercator, Zone 20, Datum WGS84) for the area. The point database includes positions in geographical decimal degrees. When the editing and building phase is finished all the GIS data are transformed to geographical decimal degrees (except for grid data) to support the ArcView GIS possibilities of changing projection. The geophysical data are imported to ARC/INFO, from the GXF format using 'in-house' software, and generated as a grid with the original projection. The original geophysical data are in floating point format and in order to improve the visual effect when displaying with colours, the grids are reclassified to integers and connected to an ASCII colour-scale file.

ArcView GIS is used to access the point databases via SQL query, extracting the relevant information and saving it either in a dBASE IV table or in ArcView GIS shape file format. ArcView GIS shape file format is used whenever points with geographic co-ordinates are involved. Some of the shape files are made with ArcView GIS Avenue scripts to separate graphical information and improve accessibility through 'click on/off' buttons in ArcView GIS.

Two customised ArcView GIS project files, for versions 2.1a and 3.0a,b, are provided on the CD. The files provide data access mechanisms that enhance the functionality of the system and their use is recommended.

Having described the overall principles some detailed information is included in relation to the principles applied for the following types of data:

- Topographical data, including Landsat TM data
- Geological data
- Geophysical data
- Geochemical data
- Licence data
- Mineral occurrence data
- Sample data

Topographical data

The topographical data have been produced in scale 1:100 000 in GEUS' photogrammetric laboratory using UTM Zone 20 and Datum WGS84. The topographical data includes sea, land, Inland Ice, lakes, rivers and 100 metre contours as lines and polygons. All features are coded with numbers (to separate the geographical map symbols) by use of ARC/INFO, before they are transformed to geographical decimal degrees.

The Landsat TM image map is a colour composite of the Landsat TM bands 4 (red), 3 (green) and 2 (blue). The map was prepared from a mosaic of the geometrically corrected sub-scenes from two nominal, system corrected Landsat TM scenes: 035-004/1994-07-02 and 035-003/1992-06-26. The ground control points (GCP) were interactively selected from the geo-referenced vectors of the topographic data.

Geological data

The geological data were prepared from a digital, photogeological interpretation of Inglefield Land (Bengaard 1995) in Datum WGS84 and UTM Zone 20. After the Survey's 1995 field season P.R. Dawes revised the geological interpretation. The revisions, made at scale 1:250 000, were scanned and used as a basis for the digitisation of new or modified elements on the screen. The south-westernmost part of the map south of Foulke Fjord (not part of Bengaard's map) was scanned from material compiled from Dawes (1997). All the feature data are coded with numbers (to separate the geological map symbols) in the proper projection by ARC/INFO before they are transformed to geographical decimal degrees.

The Minturn circles – a new type of glacial deposit – which were discovered during the 1994–95 field seasons (Appel 1996a, b) were recorded as point features. The structure of

the Minturn circles is either circular or ring shaped and up to approximately 80 m in diameter. The circles and rings are purely surficial structures consisting of boulders, cobbles and pebbles of syenite mostly covered by black lichen, hence the black colour.

Geophysical data

The source of the electromagnetic and magnetic grid data is an airborne survey flown in 1994 as the first survey of project AEM Greenland 1994–1998 (Geoterrex 1994; Stemp & Thorning 1995a, b), a project financed by the Government of Greenland to promote mineral exploration. The image grids have a spacing of 100 × 100 metres in projection UTM Zone 20 with Datum WGS84.

The source for the gravity grid data is a regional gravity survey carried out by the Geodetic Division, Kort & Matrikelstyrelsen (KMS, Copenhagen) with financial support from the Defence Mapping Agency (US) as a part of a two-year joint Danish-Canadian-US gravity project in the Nares Strait region (Forsberg *et al.* 1994, 1995). The gravity grid data representing the Bouguer anomaly are compiled to a spacing of 500 × 500 metres in projection UTM Zone 20 with Datum WGS84 from 100 point data. The gravity point data are also provided on the CD.

The total gamma-radiation data are based on data extracted from the point database (positions in geographical decimal degrees). The total gamma-radiation measurements are made at the same sites as sampled during the geochemical survey (Steenfelt & Dam 1996). The data are displayed as calculated coloured dots with haloes in the same way as the geochemical data (see following chapter).

The original grids of the geophysical maps were translated from files in GXF format to ARC/INFO grid-format using 'in-house' software, and then prepared in ARC/INFO GRID-module. The original geophysical data are already in UTM Zone 20 and Datum WGS84. In order to improve the visual effect in display in ArcView GIS, the grids are reclassified from original floating point format to integers and connected to an ASCII colour-scale file generated to match the original colour scale for the grid. The reclassified grids have integer numbers between 0 and 42, where 0 is used for 'no data' and 1 is used for shaded relief, if present, and 2 to 42 is used for the reclassified data.

All editing was done using the ARC/INFO GRID module and this work was undertaken before the release of the ArcView GIS extension Spatial Analyst. Spatial Analyst opens new possibilities for the use of floating-point data but these are still being investigated. To ensure an enhanced display of the data with colours in ArcView GIS, the method of integer reclassification of the grids was upheld. The original floating-point grids are available from different sources in GEUS and can be requested.

Geochemical data

The geochemical data are based on data extracted from the point database (positions in geographical decimal degrees) and for each analysed sample 40 trace elements and the major elements were selected. The major elements are corrected for the 'loss of ignition'. The geochemical data presented in visual form on maps were published using an 'in-house' graphical program (Steenfelt & Dam 1996). The 'in-house' graphical program was outdated and difficult to maintain, so there was strong motivation to incorporate the visual concept from the program into ArcView GIS using the macro language Avenue script.

In the original thematic map publication (Schjøth *et al.* 1996) geochemical data were displayed in ArcView GIS as graphical elements of calculated coloured dots with haloes (similar to SPOTSIZE in ARC/INFO). The dot size is calculated to reflect low-, middle- and high values as clearly as possible. Along with calculation of dot sizes the histogram and statistical parameters describing the data were also calculated and displayed in ArcView GIS as graphical elements. An ArcView GIS Avenue script was used for the calculation of dot sizes, histogram and other statistical parameters and to add these graphically to a view.

The program ArcView GIS does not provide an easy way to handle different sets of graphical elements (here more than 50 sets), so instead of presenting the dots as graphical elements, they are made as polygons (sorted circles) in a shape file. This leads to reprogramming of the original Avenue script used to produce the geochemical maps in Schjøth *et al.* (1996), so that the dots are now saved in a polygon shape file and the histogram and statistical parameters in an ASCII file. An Avenue script is provided to bring up the histogram and statistical parameters as graphical elements in the views. This method gives high flexibility of presenting geochemical data in a view because the graphical elements (histogram and statistical parameters) can be attached to the shape file in the view.

Licence data

The exclusive exploration licence data are based on the GREENMIN database (Lind *et al.* 1994). Each exploration licence area is processed with an Avenue script and saved in a polygon shape file with additional reference information in an ASCII text file. The data from the database are in geographical decimal degrees.

Mineral occurrence data

The mineral occurrence data are based on the GREENMIN database (Lind *et al.* 1994) and processed in an Avenue script to produce the different symbols representing various types of mineral occurrences by different combinations of colours and shapes. The data in the database are based on compilation of company reports from the exclusive exploration licence area (Sharp 1991) and the Survey's own investigations. The data from the database are in geographical decimal degrees.

Sample data

The sample data represent extracts of raw analytical data for rock, geochemical and geophysical data from the point database saved in each shape file. The analytical data for rock and sediment samples come from various laboratories and are analysed with different methods. To bring these analytical data into the same shape file, a three-part header of each element or major element of the periodic table in the shape files has been constructed. The three-part heading is limited to 10 characters due to the limitations of dBASE IV format. The following principles have been used to construct the three-part heading:

- The element or oxide is indicated by a prefix
- The analytical unit is indicated as an infix
- The analytical method is indicated by a suffix

Examples of the three-part headings are:

Ag_ppm(b)	:	element	= Ag
		unit	= ppm
		method	= b
SiO2_%(c)	:	oxide	= SiO_2
		unit	= %
		method	= c

The cell values (representing the combination of the sample identification and the three-part heading described above in the same shape file) are treated in the following way:

- Empty cell value denotes not analysed
- Negative cell value denotes below detection limit (the number is the detection limit)
- Positive cell value denotes the analytical value

Two tables (one is a transposed version of the other) listing the different analytical methods, analysing laboratory information and analytical detection limit are also constructed and provided on the CD-ROM.

Directory structure and GIS files on the CD-ROM

The CD-ROM with the Geoscientific Geographic Information System for Inglefield Land contains two directories at the top level, **ar301gb** and **ingle** (see sections below and Figure 1).

Please note that the directories, files and GIS layers have been given distinctive typographical appearances throughout all the figures in this report:

- **Directories**
- ***Files***
- *GIS layers*

The directory ar301gb

The directory **ar301gb** contains a guide and the software to install the English version 3.01 of Acrobat Reader for MAC, PC and UNIX users. This facility is provided for those who do not already have the Acrobat Reader software. The installation guide is in the readme-file (***Readme_m.mac***, ***Readme_w.wri*** or ***Readme_u.txt***) suitable for the user's operating system and the user should read this file carefully before proceeding with the installation.

The directory ingle

The directory **ingle** contains the directory **ar3_pdf** with the Acrobat Reader version of the original text and printed maps of the original publication of Schjøth *et al.* (1996), all GIS data for ArcView GIS software in the directory **avdata,** two ArcView GIS project files and a readme file:

- **ar3_pdf**
- **avdata**
- ***ingle21a.apr***
- ***ingle30.apr***
- ***Readme.txt***

Explanation of the above names is as follows: **av** = ArcView GIS, ***apr*** = ArcView GIS project file, **ar3** = Acrobat Reader version 3 and **pdf** = Portable Document Format. The ***21a*** and ***30*** are ArcView GIS version numbers. The contents of the sub-directories are described in the following sections.

The content of each of the project files, ***ingle21a.apr*** and ***ingle30.apr*** is equivalent; the older version is only included as a service for users who have not updated ArcView GIS. The ArcView GIS project file contains a location map, a topographic map, geological maps, geophysical maps, geochemical maps, mineral occurrence maps, exclusive exploration

licence map, and a rock and sediment sample map with raw analytical data (Figures 11, 12 and 13).

The content of the file ***Readme.txt*** summarises the basic set-up before opening the ArcView GIS project files provided on the CD-ROM. A more detailed description of the set-up is found in the chapter 'Use of the CD-ROM'.

The directory ar3_pdf

The directory **ar3_pdf** (Figure 2, with additional information in Table 1) contains all printed maps from Schjøth *et al.* (1996) and the text of that publication. The PDF-files of the maps (prefixed 'tms') are made in ArcView GIS 3.0a using the Adobe Acrobat PDFWriter version 3.01. The file ***artms961.pdf*** is the master PDF-file with the original text and links to the other files in the directory. The files ***fig1_961.pdf***, ***fig2_961.pdf*** and ***fig3_961.pdf*** are modified figures from Schjøth *et al.* (1996). The Adobe Acrobat Reader version 3.01 is the viewer for these PDF-files, which are all fully printable.

The directory avdata

The content of directory **avdata** is all the geoscientific GIS data files used by the ArcView GIS project files; see previous section and Figure 1. The GIS data files are categorised after their geoscientific topics, which here are used as sub-directories. Most of the names of the sub-directories are self-explanatory, but they will be briefly mentioned in the following sections.

Some GIS layers have suffixes with '_l' or '_p' to denote a line layer or a polygon layer, respectively. In ArcView GIS the polygon layer can be overlain by the line layer to enhance the visual display of the GIS features. Many of the GIS layers have a separate legend file. The legend field name (field in the GIS layer) is available in the Table appendix.

The sub-directory basemap

The content of the sub-directory **basemap** is shown in Figure 3 and some basic information is listed in Table 2. The name basemap refers to all basic GIS map layers, which are placed here, such as geographical information, topographical information, place names and Landsat TM image file.

The names of the GIS layers with brief explanation are as follows:

basedeg1 and *lathalf*	graticules of geographical latitude and longitude
con_l and *con_p*	contour lines spacing 100 metres altitude and polygons at 100 metre intervals
gsr	place names for the area
lake1_l and *lake1_p*	major lakes as lines and polygons. The lakes are chosen larger than 0.200 km^2
lake2_l and *lake2_p*	smaller lakes as lines and polygons
river1	major rivers as lines for the area
map_l and *map_p*	map areas covering the sea, land, local ice caps and Inland Ice as lines and polygons
ingle.tif	Landsat TM image converted to a TIFF-file format. The pixel size is 30 × 30 metres

The sub-directory etc

The sub-directory **etc** contains the TIFF-files used in the start-up of the ArcView GIS project file as a welcome banner (Figure 11) and as a map for location of Inglefield Land (Figure 12) and, as such, has nothing to do with the GIS data files.

The sub-directory geochem

The content of the sub-directory **geochem** is shown in Figures 4 and 5 and additional information is listed in Table 3. Each GIS layer in **geochem** represents selected trace element or oxide analyses of the samples from the reconnaissance geochemical mapping of Inglefield Land in 1995. The GIS layers are compiled to scale 1:500 000 and the dot sizes are proportional to the concentration in the sample.

The content of sub-directory **his_stat** is shown in Figure 5, and the files correspond to the GIS layers in the sub-directory **geochem**. All the files have the extension '.his' and are in ASCII format. The files can be displayed in ArcView GIS using the provided Avenue script assigned to the custom bottoms in the view part of ArcView GIS (Figures 14 and 16).

The sub-directory geology

The content of the sub-directory **geology** is shown in Figure 6 and additional information is listed in Table 4. The GIS layers *fault* and *trend* representing geological faults and struc-

tures are line layers. The GIS layers *geol_l* and *geol_p* represent the geological lines and polygons. The geological layers are compiled in scale 1:250 000.

The GIS layer *minturn* is a point layer representing the Minturn circles. The GIS layer is hot-linked to photographs taken from a helicopter. There are four photographs from specific locations and a general photograph of the rest of the locations. The photographs are provided as image TIFF-files and located in the sub-directory **photo**. The accompanying legend file displays the specific and general photographs through different sizes of point markers, and the hot-link field of the GIS layer activates the photographs (see Table 4).

The sub-directory geophys

The content of the sub-directory **geophys** is shown in Figure 7 and additional information is listed in Table 5. The sub-directory contains three GIS layers and eight image grids. The GIS layers are total gamma-radiation measurements, GEOTEM anomalies and gravity observation points.

All the image grids are reclassified from the original floating point numbers to integer numbers between 0 and 42 to achieve an easy way to colour the grids in ArcView GIS through a colour-scale file provided in the same sub-directory. The explanation to the integer numbers between 0 and 42 is provided in Table 5.

The names of the GIS layers and image grids with brief explanation are as follows:

acdh_cl	reclassified calculated apparent conductivity grid
ba_class	reclassified bouguer anomaly grid
gammaray	total gamma-radiation measurement point layer
geotem_p	GEOTEM anomaly point layer
gravpoin	gravity observation point layer
tfsrcol	reclassified total magnetic intensity colour grid with shaded relief
tfsrgrey	reclassified total magnetic intensity grid as shaded relief
tf_class	reclassified total magnetic intensity colour grid
vgsrcol	reclassified calculated magnetic vertical gradient colour grid with shaded relief
vgsrgrey	reclassified calculated magnetic vertical gradient grid as shaded relief
vg_class	reclassified calculated magnetic vertical gradient colour grid

The sub-directory licences

The content of the sub-directory **licences** is shown in Figure 8 and additional information is listed in Table 6. The names of the GIS layers are prefixed with 'els' for exploration licence and are suffixed with the Survey internal claim number. The accompanying legend file displays the different exclusive exploration licence areas while the hot-link field of the GIS layer activates the ASCII text file with basic information, references, and company reports on the exclusive exploration licence area (see Table 6).

The sub-directory minocc

The content of the sub-directory **minocc** is shown in Figure 9 and additional information is listed in Table 7. This sub-directory contains two GIS layers for mineral occurrences of iron, and base and noble metal mineralisation. It has been necessary to separate the iron mineralisation into two layers: one layer includes general iron mineralisation and the other iron associated with rust zones. The two layers are:

cuznfeau	Cu, Zn, Fe and Au
fe_sulph	Fe sulphides associated with rust zones

The sub-directory samples

The content of the sub-directory **samples** is shown in Figure 10 with additional information listed in Tables 8 to 13. This sub-directory contains GIS layers with measurement of total gamma-radiation and original raw analytical data of rock and sediment samples, additional files with detection limits of the analytical data, and a file with description of all rock samples.

The files ***dl.dbf*** and ***dl_trans.dbf*** are detection limit files, the latter a transposed detection limit file of the first file. Analytical methods, analytical laboratories and the change of detection limits through the years have been combined to create internally unique laboratory labels in an ArcView GIS table (dBASE IV format).

The file ***rockdesc.dbf*** contains information from the GEUS standard sample 'docket book' filled out in the field. Additional information may be added later. The different items are listed in Table 13.

The GIS layer *gammaray* contains gamma radiation readings measured in connection with the geochemical sampling program.

The GIS layers *geochem* and *rock* contain original analytical data of the samples. Many samples are analysed using more than one method so the headings in the ArcView GIS table indicate the analysed element, the unit of measurement and the analytical method. The headings in the table are therefore constructed of three parts; the first part is the name

of the analysed element, the second part is the units used and the third part is the analytical method (for examples see Tables 11 or 12). The cell value represents the combination of the sample identification and the three-part heading, therefore an empty cell value denotes not analysed, a negative cell value denotes below detection limit (the number is the detection limit) and a positive cell value denotes the analytical value.

Use of the CD-ROM

This CD-ROM contains a geoscientific GIS dataset for Inglefield Land for users with an ArcView GIS software licence. There are some hardware and software system requirements to consider before the dataset can be used, and some adjustment to the operating system is required before opening the ArcView GIS project files.

This chapter describes:

- System requirements
- The GIS CD-ROM's directory structure
- Before opening the ArcView GIS project file
- ArcView GIS project files and GIS data files
- How to open the customised ArcView GIS project file

System requirements

This GIS CD-ROM data package is made for ArcView GIS version 2.1a and 3.0a,b running on one of the following operating systems Windows 3.11, Windows 95, Windows NT 4.0 or UNIX.

The ArcView GIS project files (Figure 1), for both ArcView GIS version 2.1a and version 3.0a,b, on the CD-ROM data package have been executed and successfully tested on PCs with a Pentium processor, 32 Mb RAM, graphic interface of 2 Mb and on all of the operating systems mentioned above. The ArcView GIS project files on the CD-ROM data package have also been executed and successfully tested on a PC with a 486DX processor, Windows 95, 32 Mb RAM, graphic interface 1 Mb and ArcView GIS 2.1a, but it runs extremely slowly (e.g. the opening of the customised project file takes more than 5 minutes).

We recommend a PC with at least a Pentium processor, 32 Mb RAM and a graphic interface with at least 2 Mb.

The GIS CD-ROM's directory structure

The GIS CD-ROM's directory structure is described in Figure 1 and in the previous chapter. The top directories are **ar301gb** and **ingle**. All GIS data are organised in **ingle**. The ArcView GIS project files (Figure 1), for both ArcView GIS version 2.1a and 3.0a,b, on the GIS CD-ROM use a logical variable in order to make it independent of the drive letter of the PC's CD-ROM. The organisation of data in the directory **ingle** and the use of a logical variable ensure high and independent portability of the data, e.g. if data are moved to another location on a hard drive. The set-up of the logical variable is described in the following section.

Before opening the ArcView GIS project files

The ArcView GIS project files on the CD-ROM (Figure 1), for both ArcView GIS version 2.1a and 3.0a,b, use a logical variable which supports easy access to, and portability of, the GIS data on the CD-ROM. If the GIS data are moved from the CD-ROM to the hard drive the user only has to define or redefine the value of the logical variable. The logical variable must be given the name 'GMXINGLE'.

Below it is shown how to set up the logical variable on various operating systems; in this case the CD-ROM drive letter is 'G:' on a PC or '/cdrom' on a UNIX workstation.

Windows 3.11 and Windows 95:

- edit ***autoexec.bat*** file
- add a new line 'set GMXINGLE=G:'

Windows NT 4.0:

- open Start>Settings>Control Panel>System>Environment>Uservariable
- add Variable = GMXINGLE and Value = G:

UNIX (C-shell CD-ROM drive '/cd_rom'):

- edit the '***.cshrc***' or equivalent file
- add on a new line 'setenv GMXINGLE=/cdrom'

After defining the logical variable apply an appropriate restart of the computer.

ArcView GIS project files and GIS data files

The location of the customised ArcView GIS project files for the ArcView GIS version 2.1a and version 3.0a,b is seen in Figure 1. The files of the two versions are equivalent in functionality and the only difference is the designed version. The files provide data access mechanisms that greatly enhance the functionality of the system and its use is recommended.

The ArcView GIS data files are located in sub-directory **avdata** (Figure 1 with references to other figures). This sub-directory contains all the geoscientific GIS data files used by the accompanying ArcView GIS project files.

How to open the customised ArcView GIS project file

Opening of one of the customised ArcView GIS project files first activates the start-up script inside the project file. The start-up checks the users screen size and adjusts the project file to the users actual screen size. Then the welcome banner appears on the screen (Figure 11).

After manually closing the welcome banner there are two open windows in ArcView GIS (Figure 12). The window on the left side shows the content of the project file (see also Figure 13) and the right side window shows the location of Inglefield Land on a map of Greenland.

In the view of the project file there are six special buttons, which each activate a special Avenue script (Figure 14). The buttons activate three different functions which are indicated on Figure 14 with references to other figures.

- The buttons in Figure 15 adjusts the active window to either full size on the user screen or to a reduced size so that the project window is visible on the user screen

- The buttons in Figure 16 are mainly for use when the 'Geochemistry' view is open. The button to the left activates the 'Statistics and Histogram' view, deletes all graphics in the view and prompts the user for a new ASCII file with extension '.his' (Figure 5). When the user chooses one of the accompanying files the graphics are shown in the view 'Statistics and Histogram'. The right button opens and activates the 'Statistics and Histogram' view

- The buttons in Figure 17 adjusts and move the active window. The adjustment of the active window almost fit an 800 × 600-pixel screen. The button on the left side moves the active window to the upper left corner of the ArcView GIS window. The right button moves the active window so that the project window is visible on the user screen

A reasonably experienced ArcView GIS user armed with this information will be able to explore the compiled data and make new combinations.

Acrobat Reader version of TMS 96/1

This digital publication of maps from Inglefield Land provides access to sample data and opens the possibility of using the digital data behind the maps. It does not generate any new geoscientific information. In order to make the original publication of Schjøth *et al.* (1996) readily available for users of the CD-ROM, an Acrobat Reader version of that publication, including the maps, has been produced and placed on the CD-ROM. Adobe Systems Inc. supplies the Acrobat Reader program free of charge. This program and the files necessary to install it on a PC have all been included on the CD-ROM.

The Acrobat Reader version has been prepared from the text and maps published in 1996. Though the information has not been changed, three modifications have been carried out to the text when using Acrobat Reader.

- Fonts and layout better suited for reading on a screen
- Language corrections
- Inclusion of new references

The master PDF-file is the one containing the main text (***artms961.pdf***) in the sub-directory **ingle\ar3_pdf** on the CD-ROM. If Acrobat Reader has been installed, just double-click on this file to open the main document. This contains the edited original text and links to all maps and figures. It is useful to note that the following principles have been applied for the definition of links.

- Text in blue colour provides a link to elsewhere in the main text document. It is recommended to use the previous/next view buttons to return to the position before a jump

- Text in red colour provides a link to one of the thematic maps, each in a separate file. It is recommended to leave the map by closing the window containing the map; this will bring the user back to the position in the main document before the jump to the next map (see the last point below). The map PDF-files contain no links

- At the top of all text pages there are links to 'Table of Contents' and 'List of maps'; the margins to the left and right of the text provide similar links

- Acrobat Reader standard facilities can be used to navigate, zoom, and print the documents. It is recommended **not** to open a second document (e.g. a map) in the **same** window (see files > preferences > general - **no** tick in 'Open Cross-document Links in Same Window')

Discussion

Since 1992, when the Department of Economic Geology purchased the GIS program ARC/INFO, an ESRI product (ESRI Inc. = Environmental Systems Research Institute Incorporation), it has been the overall intension to use GIS programs to create, edit, update and print the basic vector GIS data. At approximately the same time the department also obtained the PCI Systems (PCI Inc. = Paradyme Consultants International Incorporated; PCI is equivalent to ERDAS Imagine; ERDAS Imagine cooperate with ESRI) to handle satellite images covering Greenland. PCI Systems software is also a GIS tool and it also supports ARC/INFO formats. The desktop program ArcView GIS (an ESRI product) did not exist at that time so that all the compilations, and paper prints were undertaken using ARC/INFO and an 'in-house' program. Later, when the desktop program ArcView GIS appeared on the market it showed promise as a viewing and printing tool, but the program still required adjustments to fulfil the requirements. As later and better ArcView GIS versions became available, the adjustments through Avenue script turned out to be a minor task, and the strategy could be revised to depend more on the use of ArcView GIS for the release of GIS data on a CD-ROM.

The ARC/INFO and PCI Systems software runs on a Digital UNIX Workstation with a limited numbers of licences. The ARC/INFO program is used to generate, edit, build and revise the basic GIS features of points, lines, polygons and grids, normally in a UTM projection with Datum WGS84. Coding with integer (after an internal standard for the Department of Economic Geology) separates different features (point, line or polygon features) into map features. Previously it would have been necessary to create one or several look-up tables to handle the map symbolisation, but as the desktop ArcView GIS program does not support look-up tables directly, it was decided instead to build legend files in ArcView GIS for the map symbolisation.

After coding and reclassification the basic GIS data are positioned in latitude and longitude (decimal degrees), except for grids, which for technical reasons are in UTM Zone 20 and Datum WGS84. Subsequently, the basic GIS data are moved to an appropriate directory on the Digital UNIX Workstation accessible on the Survey's Intranet.

The ArcView GIS runs both on the Digital UNIX Workstation/server and on PCs in the department. All in the department access the GIS data through ArcView GIS on their own PC. If the GIS data are issued digitally on a CD-ROM additional editing is required. The GIS data files are accessed through ArcView GIS on a PC, converted to ArcView GIS shape files (ArcView GIS standard file format) and saved on the PC. The shape files are then edited using ArcView GIS on the PC by:

- Deleting all ARC/INFO internal attribute items including 'Area', 'Perimeter' in the polygon feature and 'Length' in the line feature (the GIS data is in geographical projection)

- Adding clear text in new fields to explain the coding of the map symbols and adding other fields where necessary for additional information

- Building legends to the shape files in ArcView GIS using special Avenue scripts

This combined use of ARC/INFO, to build basic GIS data sets, and subsequently ArcView GIS, for modifications and analyses, utilises both systems and has proved to be a very efficient working method.

The point databases with the attribute data were accessed through ArcView GIS by SQL-link queries and saved as dBASE IV format files. The point database contains geographical co-ordinates in decimal degrees. The attribute data come in various files depending on the analytical method used (one file per method). The files were merged to one dBASE IV formatted file by interchangeable use of ArcView GIS and Microsoft Office Excel 97. During the editing phase in ArcView GIS the dBASE files were added as 'event theme', and finally the 'event themes' were converted to a shape file and the legend file was built.

For geochemical point data a special Avenue script was made to display the analytical data as circles dependent on the analytical values and to calculate statistical and histogram parameters. Circles for each element were saved in a sorted polygon shape file and an ASCII file created to hold the statistical and histogram parameters (done by an Avenue script not provided on the CD-ROM). An Avenue script is provided to visualise the statistical and histogram parameters by importing the ASCII file. The creation of one shape file per element makes it possible to analyse the geochemical data together with other data.

To keep track of element names, methods and units of the analyses, the name of the column in the table is constructed in three parts. Due to the restriction of field names to ten letters in a dBASE file, an additional dBASE table is created containing the description of the methods, including detection limits of the particular elements. This additional table cannot be linked or joined to any other tables in ArcView GIS; it only serves as information for those who want to model the analytical results.

When all of the processing described above has been completed using ARC/INFO, ArcView GIS and Microsoft Excel software, customised ArcView GIS project files are built and put on the CD-ROM. The project files are available in two ArcView GIS formats (version 2.1a or 3.0a,b). The project file also provides data access mechanisms to enhance the functionality of the system; their use is recommended. The two ArcView GIS project file versions are identical in content and the older version is only provided as a service for users who have not updated their ArcView GIS installation. Some additional Avenue scripts are provided in the project file to enhance the functionality for the user, such as a zooming

effect on the active view and import and display of accompanying ASCII files with statistical and histogram parameters.

We have also tested the extension 'Spatial Analyst' to ArcView GIS 3.0a for a replacement of the ARC/INFO GRID module. Spatial Analyst handles most tools on grids, but when it comes to statistical calculation and contouring of data, it is not easy to use. To fulfil our demands on grid data and to solve our contouring demands, we use OASIS montaj (OASIS montaj is a trademark of Geosoft Incorporated), which is designed to analyse geophysical, geochemical and other data types. The results from analysing with OASIS montaj are then represented in ARC/INFO GRID module and accessed by ArcView GIS.

The freeware ESRI ArcExplorer (version 1.1.2) has been tested as a viewer for the digital GIS data. It is found that the current version only works on ArcView GIS shape files, ARC/INFO layers/covers plus other minor facilities. The program is, for example, not capable of displaying the grid files provided on the CD-ROM. The digital GIS data are somehow displayed with X and Y co-ordinates and for a high latitude area such as Inglefield Land, it is not an appropriate view for working on the data. The program simply lacks the projection facilities, but the promised updates of the program will have at least the projection facilities available.

Another helpful program is Adobe Acrobat version 3.0. We have used the facility to make a digital version of the paper publication of Schjøth *et al.* (1996) including hyperlink to the map files. We have used the Adobe PDFWriter from within ArcView GIS to create the PDF-files of the maps from the publication.

Working with PDF-files we discovered some additional facilities which are lacking in ArcView GIS. It has always been a problem to use files exported from ArcView GIS in other programs, because for example, ArcView GIS's Postscript files could not be imported to other desktop programs such as Adobe Illustrator. Another thing is that when a layout in ArcView GIS is defined for example A3, it is not possible to scale it down to A4. The PDF-files support these facilities and this discovery is a great relief. The PDF-files can be imported to Adobe Illustrator 7.0 and they are fully editable as a native Adobe Illustrator 7.0 format. Unfortunately this only works on PCs and NOT on a MAC computer, due to the way the ESRI TrueType fonts are handled on the PC and these fonts are not available on a MAC.

Conclusions

In 1998, in the Department of Economic Geology, the general scenario working with GIS and associated programs is:

- ARC/INFO on Digital UNIX is used to create, edit and compile basic GIS data
- PCI system on Digital UNIX is used for satellite image analysing tools
- ArcView GIS is the desktop program used to view, analyse and print or plot GIS data
- ArcView GIS is used to build legend files, eventually with use of Avenue scripts
- OASIS montaj is used to analyse geophysical, geochemical and other data types, especially where gridding and contouring purposes involved
- The freeware ESRI ArcExplorer (version 1.1.2) is not a suitable viewer for the digital GIS data. The program lacks projection facilities and does not support the grid file format
- Adobe Acrobat PDFWriter from within ArcView GIS is used to create PDF-files of the ArcView GIS's view or layout
- Adobe Illustrator (version 7) for PCs has the facility to import PDF-files and work professionally on the file. Unfortunately it only works on PC and not on the MAC computers
- Adobe Acrobat Exchange is used to create files with hyperlinks and users can view this document using the Adobe Acrobat Reader, which is downloaded free from the Internet
- Adobe Acrobat PDFWriter facilitates scaling of documents from 100% down to 25% when used from within ArcView GIS. The maximum size of document output from the Adobe Acrobat PDFWriter is a page size 114.3 cm × 114.3 cm. The PDF file is then printed to sizes provided by the printer using Adobe Acrobat Reader

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List of figures

Figures

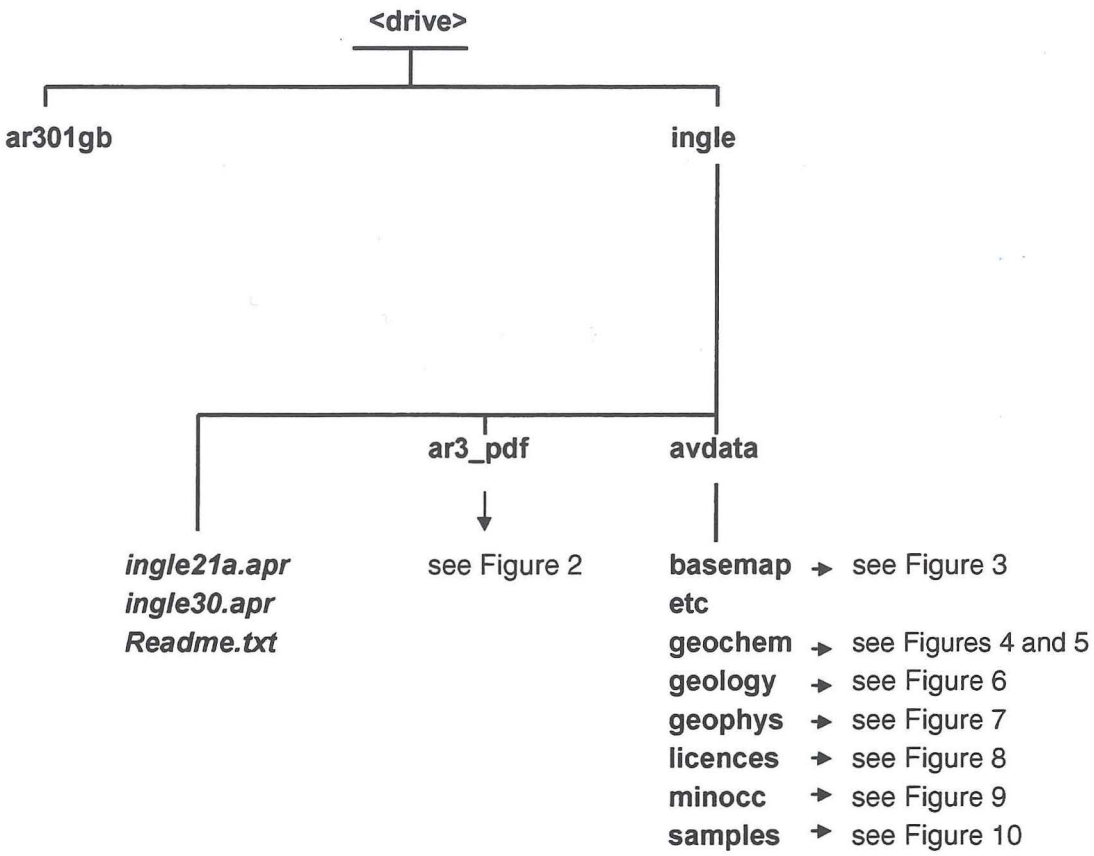

Figure 1. *The directory structure of the GIS CD-ROM package (the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive). The sub-directory* **etc** *contains TIFF-files used in the start-up of the ArcView GIS project file as a welcome banner. An arrow points to a reference to another figure in normal text.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

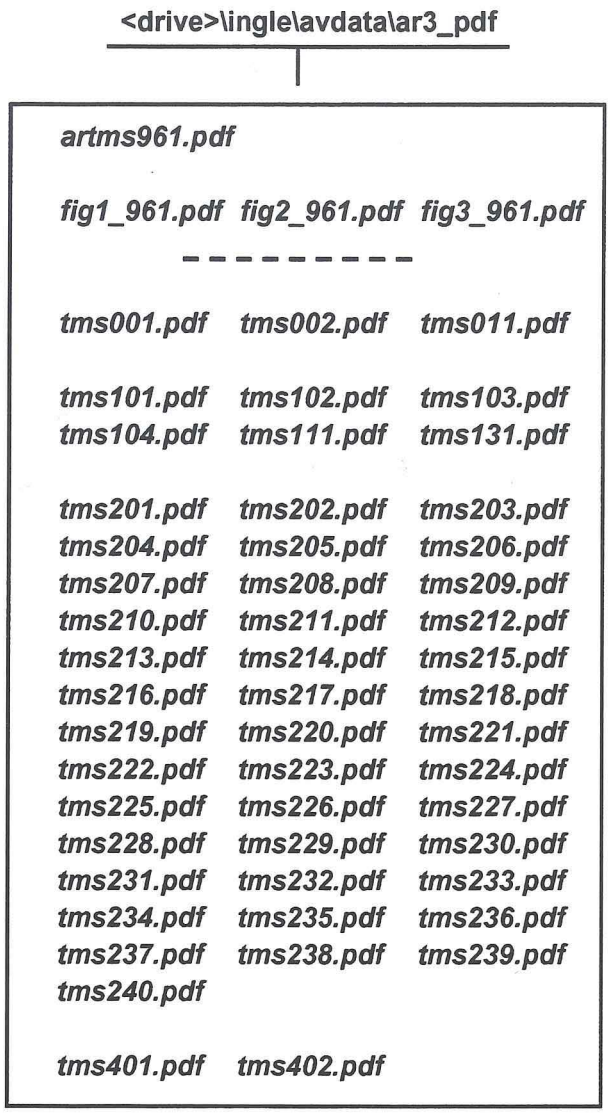

Figure 2. *The content of directory* **ar3_pdf** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive). At top (above the stippled line) the file* ***artms961.pdf*** *is the master PDF-file with links to the other files. The files* ***fig1_961.pdf, fig2_961.pdf*** *and* ***fig3_961.pdf*** *are modified figures from Schjøth et al. (1996). ArcView GIS 3.0a via Adobe Acrobat PDFWriter version 3.01 was used to create the map PDF-files (below the stippled line, all prefixed '**tms**'). All files are from Schjøth et al. (1996). The Adobe Acrobat Reader version 3.01 is the viewer for these PDF-files and they are fully printable. See also Table 1.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

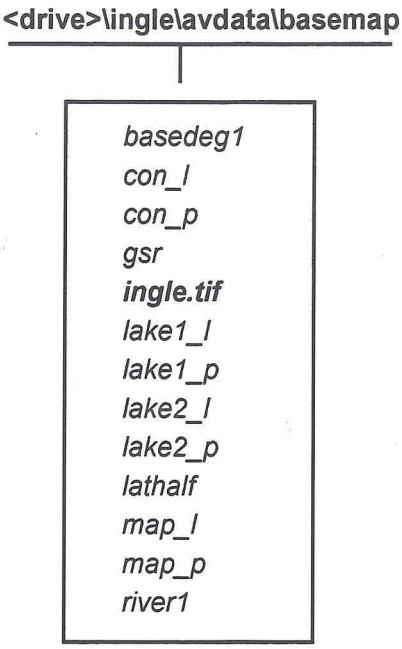

Figure 3. *The GIS layers in sub-directory* **basemap** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive) as seen from within ArcView GIS. The suffix _l denotes line layer and suffix _p denotes polygon layer. The attribute table fields of the layers are self-explanatory, and only the basic information is provided in Table 2.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

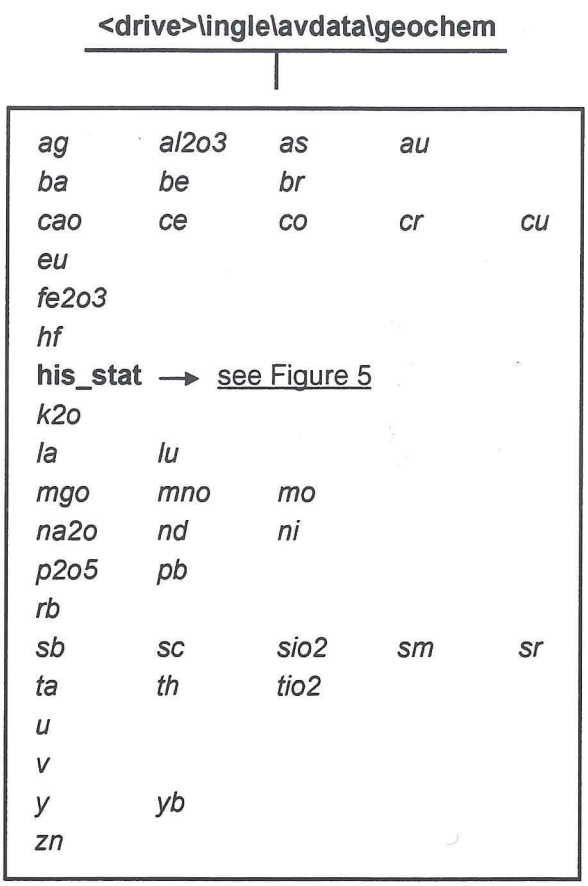

Figure 4. *The GIS layers and directories in sub-directory* **geochem** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive) as seen from within ArcView GIS. Information and explanation to the attribute table fields of the GIS layers are provided in Table 3.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

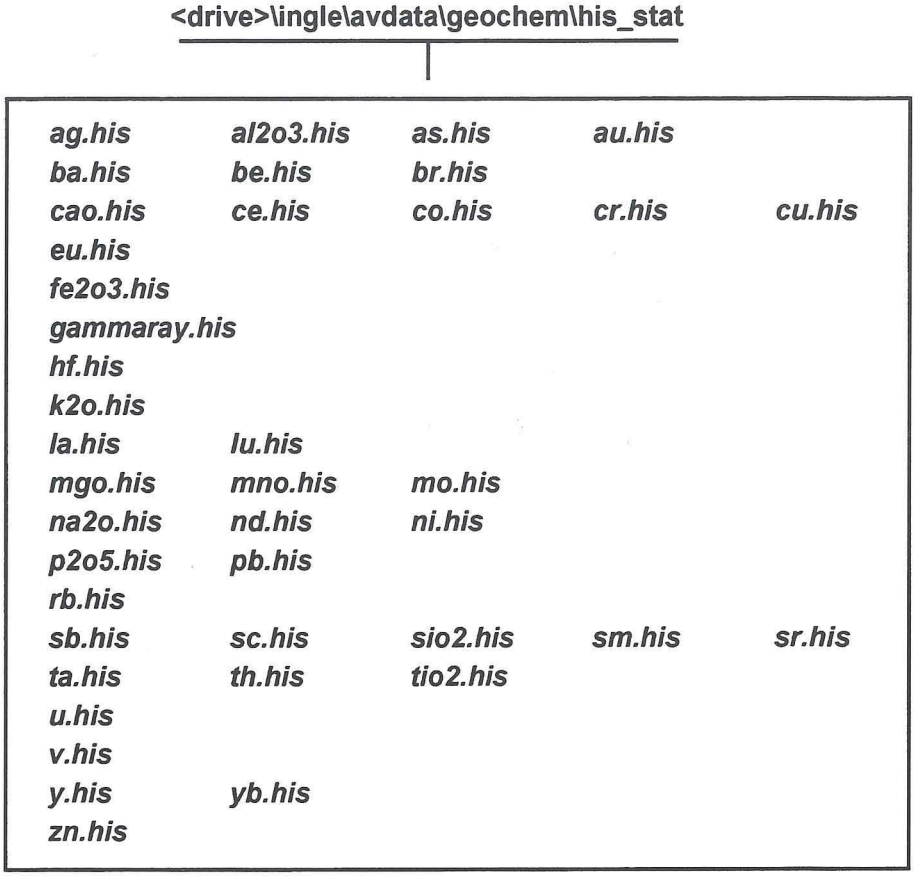

Figure 5. *The histogram and statistic data files in sub-directory* **his_stat** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive) are directly related to GIS layers in the sub-directory* **geochem**. *The data files are in a specially designed ASCII-format and not meaningful without the ArcView GIS script provided in the ArcView GIS project file. The files are viewed graphically by pressing the custom button in ArcView GIS (see also Figures 14 and 16), which is connected to the provided Avenue script.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

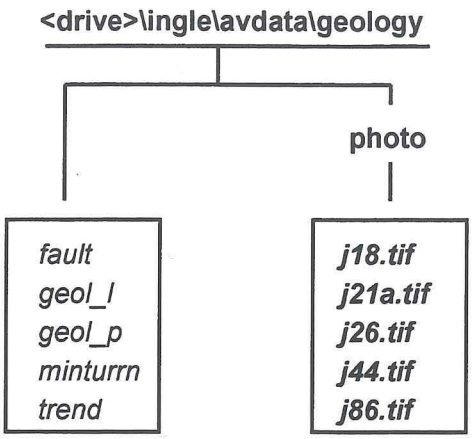

Figure 6. *The GIS layers in sub-directory* **geology** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive) as seen from within ArcView GIS. The sub-directory* **photo** *contains photographs of Minturn circles, where* ***j86.tif*** *is a general photograph and the others are from specific locations. The separation of general and specific locations is in the legend file* ***minturn.avl****. The photographs are viewed through hot-links provided in the GIS layer minturn. Information and explanation to the attribute table fields of the GIS layers are provided in Table 4. The suffix _l denotes a line layer and suffix _p denotes a polygon layer.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

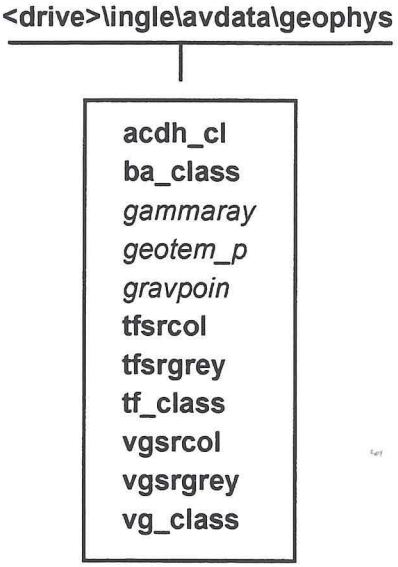

Figure 7. *The GIS grids (which here are sub-directories) and layers in sub-directory* **geophys** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive) as seen from within ArcView GIS. The suffix _p denotes point layer. Information and explanation to the grids with corresponding colour file and the attribute table fields of the GIS layers are provided in Table 5.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

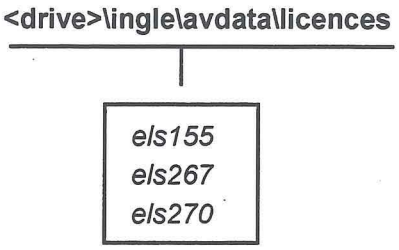

Figure 8. *The GIS layers in the sub-directory* **licences** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive) as seen from within ArcView GIS. Information and explanation to the attribute table fields of the GIS layers are provided in Table 6.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

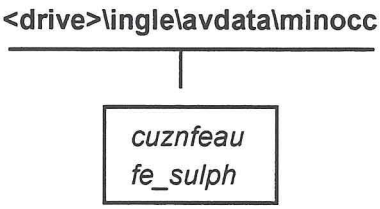

Figure 9. *The GIS layers in the sub-directory* **minocc** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive). Information and explanation to the attribute table fields of the GIS layers are provided in Table 7.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

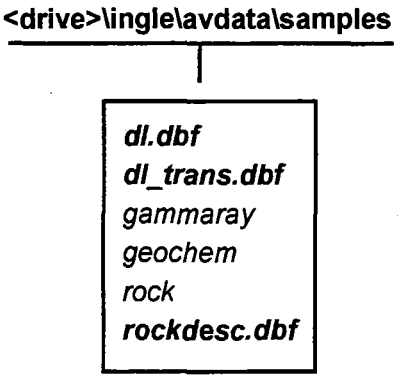

Figure 10. *The GIS layers and tables in the sub-directory* **samples** *(the <drive> represent your CD-ROM drive letter, e.g. G: for CD-ROM on the G-drive). Information and explanation to the attribute table fields of the GIS layers are provided in Tables 8–13.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

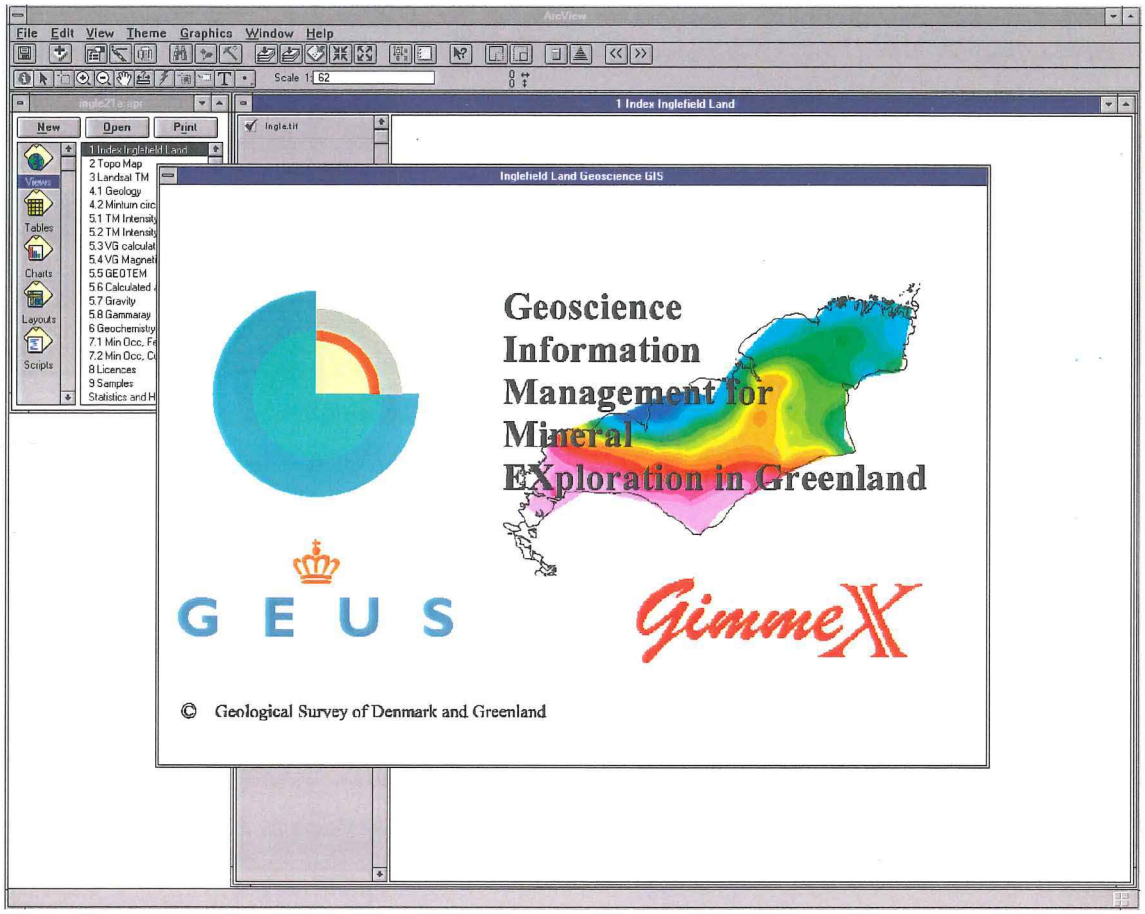

Figure 11. *This opening scene appears when the accompanying ArcView GIS project files in the geoscientific GIS CD-ROM package is opened by ArcView GIS. The welcome banner is in front and users have to manually close the welcome banner.*

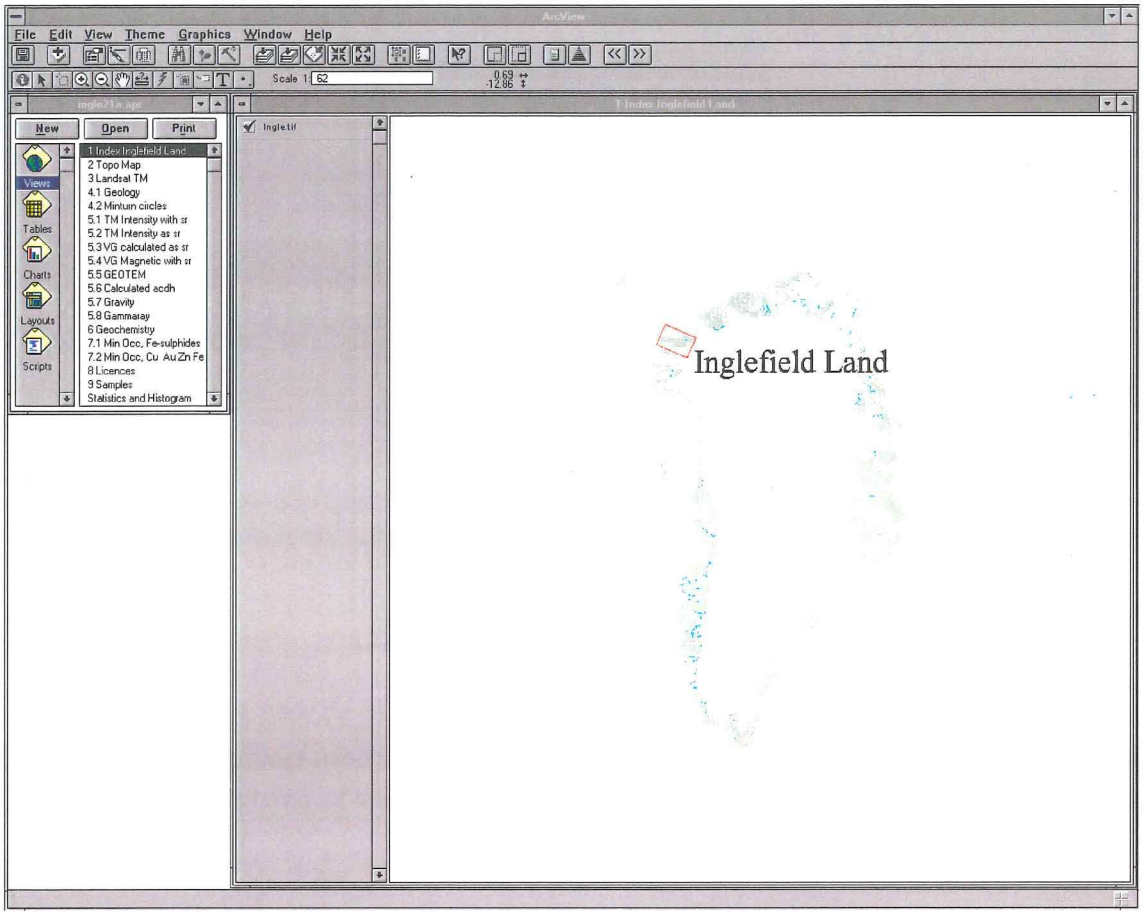

Figure 12. *The scene after closing the welcome banner from the accompanying ArcView GIS project file. The project window (see also Figure 13) is shown on the left side and the location of Inglefield Land is shown in the window on the right side.*

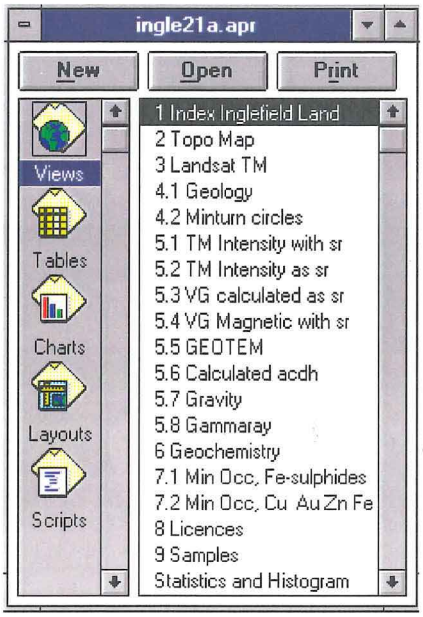

Figure 13. *The project window in ArcView GIS. The list in the project window is numbered to give a logical ordering of the contents. The decimal numbers indicate a suborder within a category, if present.*

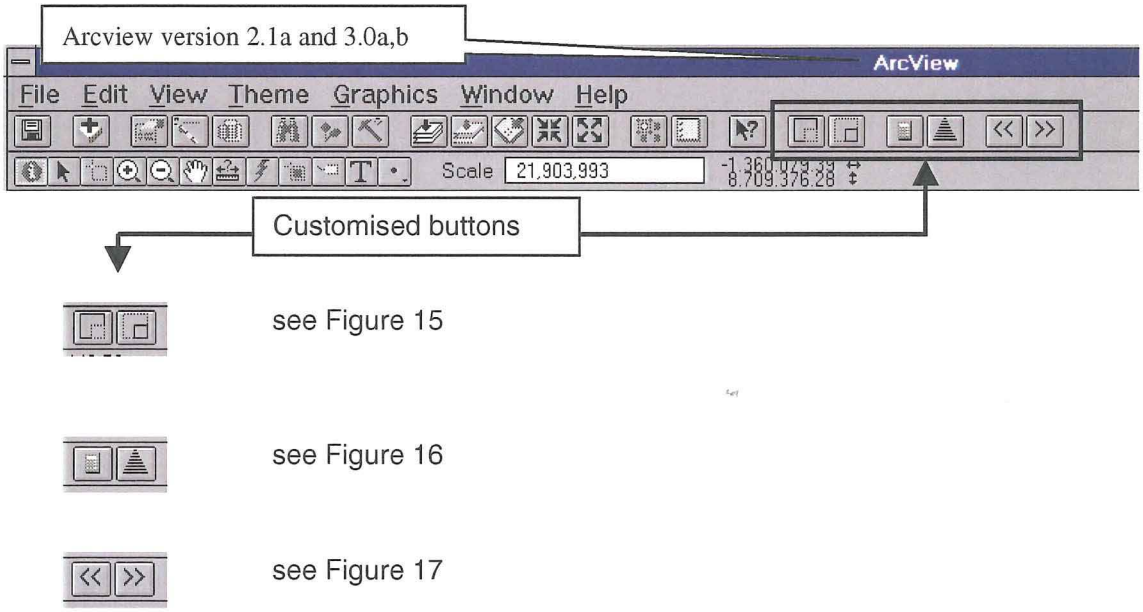

Figure 14. *Standard ArcView GIS view command bar with additional custom buttons. The custom buttons are linked to Avenue script in the project file. The functions of the custom buttons are described in Figures 15 to 17.*

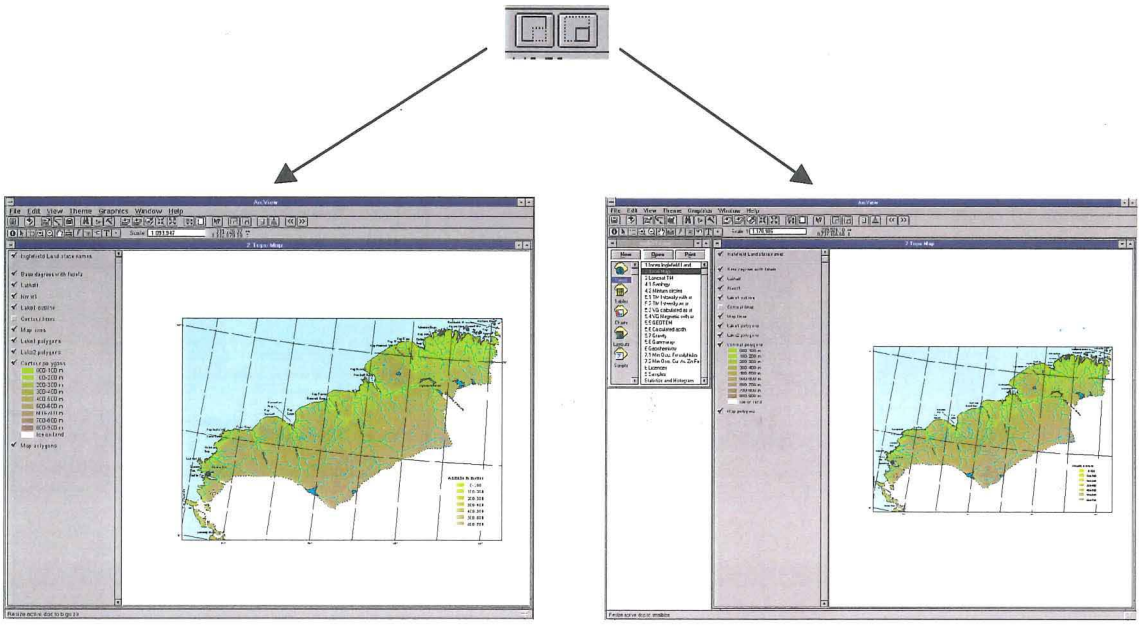

Figure 15. *The buttons adjust the active window in ArcView GIS. The left button adjusts the active window to full size and the right button adjusts the active window so the project window is visible.*

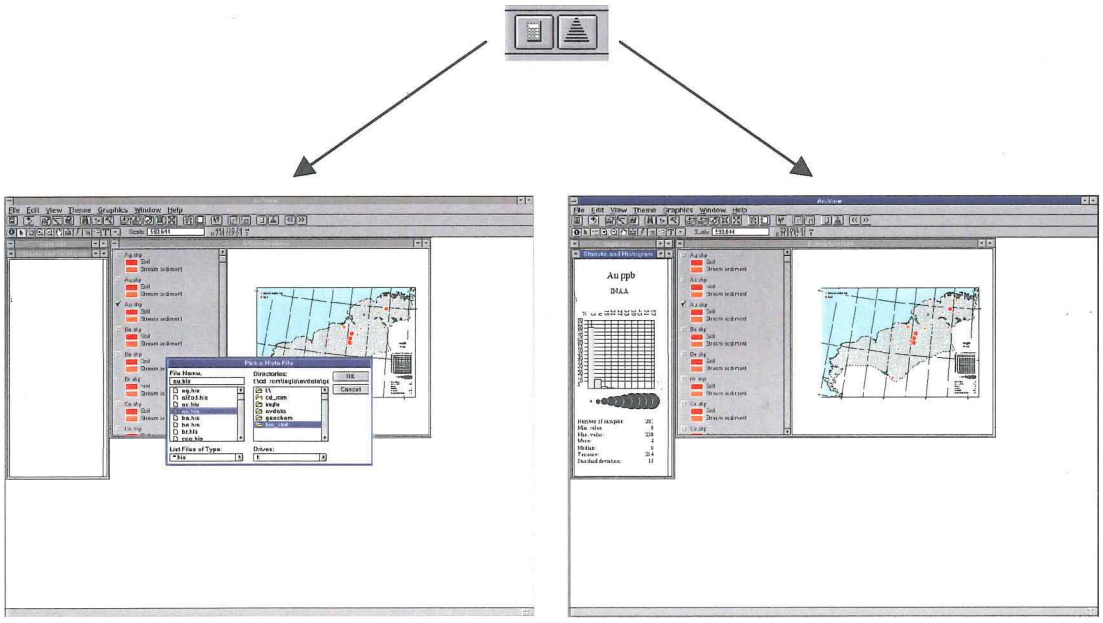

Figure 16. *The two buttons open a view in order to give a closer look at the statistics and histograms provided with the geochemical data including the gamma-radiation from the geophysical data. The left button activates the 'Statistics and Histogram' view, resets the graphics in the view and opens a menu with a list of files to be picked for closer inspection. When a file is picked it is displayed in the view. The right button only activates the 'Statistics and Histogram' view.*

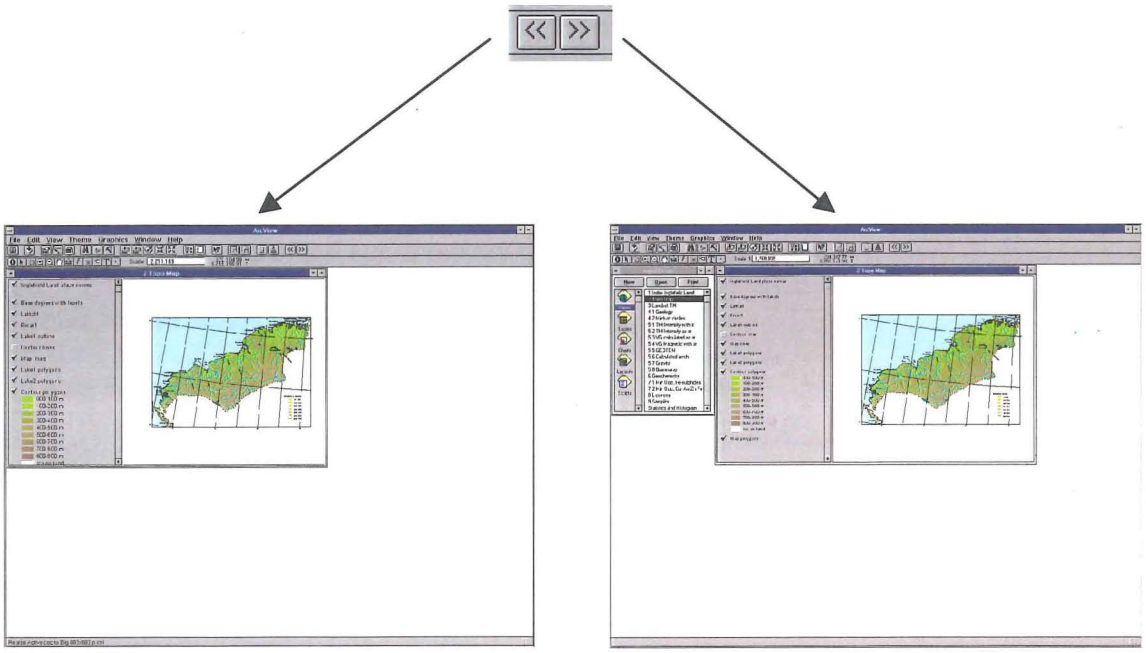

Figure 17. *The buttons adjust and move the active window either left or right. The size of the adjusted window is close to fit an 800 × 600-pixel screen. The advantage here is to obtain a visible active window if the window by accident has been moved outside the visible screen area.*

List of tables

Tables

Directory	**<drive>\ingle\ar3_pdf**
File system size	20 Mb
Date of last update	October 1998
Data custodian	Frands Schjøth & Leif Thorning

General description of file content:

General

tms001.pdf Topography, drainage and place names

tms002.pdf Landsat TM map

Geology

tms011.pdf Geological map

Magnetic and electromagnetic

tms101.pdf Total magnetic intensity with shaded relief

tms102.pdf Calculated magnetic vertical gradient

tms103.pdf GEOTEM transient EM anomaly map

tms104.pdf Calculated apparent conductivity map

Gravimetry

tms111.pdf Bouguer anomalies

Gamma-radiation

tms131.pdf Total gamma-radiation

Stream sediment and soil geochemistry, element and oxide distribution maps

tms201.pdf	SiO_2 %	***tms202.pdf***	TiO_2 %	***tms203.pdf***	Al_2O_3 %
tms204.pdf	Fe_2O_3 %	***tms205.pdf***	MnO %	***tms206.pdf***	MgO %
tms207.pdf	CaO %	***tms208.pdf***	Na_2O %	***tms209.pdf***	K_2O %
tms210.pdf	P_2O_5 %	***tms211.pdf***	Ag ppm	***tms212.pdf***	As ppm
tms213.pdf	Au ppb	***tms214.pdf***	Ba ppm	***tms215.pdf***	Be ppm
tms216.pdf	Br ppm	***tms217.pdf***	Co ppm	***tms218.pdf***	Cr ppm
tms219.pdf	Cu ppm	***tms220.pdf***	Hf ppm	***tms221.pdf***	Mo ppm
tms222.pdf	Ni ppm	***tms223.pdf***	Pb ppm	***tms224.pdf***	Rb ppm
tms225.pdf	Sb ppm	***tms226.pdf***	Sc ppm	***tms227.pdf***	Sr ppm
tms228.pdf	Ta ppm	***tms229.pdf***	Th ppm	***tms230.pdf***	U ppm
tms231.pdf	V ppm	***tms232.pdf***	Y ppm	***tms233.pdf***	Zn ppm
tms234.pdf	La ppm	***tms235.pdf***	Ce ppm	***tms236.pdf***	Nd ppm
tms237.pdf	Sm ppm	***tms238.pdf***	Eu ppm	***tms239.pdf***	Yb ppm
tms240.pdf	Lu ppm				

Mineral occurrences

tms401.pdf Fe sulphides (associated with rust zones)

tms402.pdf Cu, Au, Zn, and Fe (base metals, noble metals and magnetite)

Table 1. *The upper part of the table contains general information on the directory* **ar3_pdf**. *The lower part of the table lists the map PDF-files with a brief explanation. ArcView GIS 3.0a via Adobe Acrobat PDFWriter version 3.01 was used to create these PDF-files. The Adobe Acrobat Reader version 3.01 is the viewer for these PDF-files and they are fully printable. See also Figure 2.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***. *Modified after Schjøth et al. (1996).*

Directory		**<drive>\ingle\avdata\basemap**	
File system size		50 Mb	
Date of last update		October 1998	
Data custodian		Frands Schjøth	
ArcView GIS layers	Legend field	Legend file	Description
basedeg1			Basic latitudes and longitudes in 1 degree net
con_l	Countour	***con_l.avl***	Contour lines 100 metres
con_p	Cont_int	***cont_int.avl***	Contour polygons 100 metres on land
gsr			Place names Inglefield land
ingle.tif			Landsat TM of Inglefield Land in TIF-format
lake1_l	Linecode	***lake1_l.avl***	Major lakes outline > 0.200 km^2
lake1_p	Lakecode	***lake1_p.avl***	Major lakes polygon > 0.200 km^2
lake2_l	Linecode	***lake2_l.avl***	Minor lakes outline < 0.200 km^2
lake2_p	Lakecode	***lake2_p.avl***	Minor lakes polygon < 0.200 km^2
lathalf			One ½ degree latitude
map_l	Linecode	***map_l.avl***	Inglefield Land map outline including frame
map_p	Mapcode	***map_p.avl***	Inglefield Land map polygon including frame
river1	Rivercode	***river1.avl***	Major rivers in Inglefield Land

Table 2. *The upper part of the table contains general information on the sub-directory* **basemap**. *The lower part of the table lists the basic information on GIS layers. 'Legend field' shows the attribute table field for adding the ArcView GIS legend file provided in* **basemap** *(.avl file, e.g.* ***con_l.avl*** *is loaded to attribute table field Contour in con_l layer). The suffix _l denotes line layer and suffix _p denotes polygon layer. See also Figure 3.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Directory	**<drive>\ingle\avdata\geochem**
File system size	61 Mb
Date of last update	October 1998
Data custodian	Agnete Steenfelt
ArcView GIS layers	*ag* *al2o3* *as* *au* *ba* *be* *br* *cao* *ce* *co* *cr* *cu* *eu* *fe2o3* *hf* *k2o* *la* *lu* *mgo* *mno* *mo* *na2o* *nd* *ni* *p2o5* *pb* *rb* *sb* *sc* *sio2* *sm* *sr* *ta* *th* *tio2* *u* *v* *y* *yb* *zn*
Number of layers	40
Legend file	***geochem.avl***
Record count	Between 263 and 281 for each layer depending on analysis method
Attribute table fields	Description
Id	Local id with value 1 as the largest polygon and nn as the smallest polygon
Sample_id	Survey internal sample identifier
Stype	2 characters sample type and legend attribute field to legend file ***geochem.avl***
Stype_text	Full text of Stype

Table 3. *The upper part of the table contains general information on the sub-directory* **geochem** *including the names of the GIS layers and ArcView GIS legend file provided in* **geochem** *(.avl file, e.g.* ***geochem.avl*** *is loaded to attribute table field Stype). The lower part of the table lists a general description of the attribute table fields to each of the 40 GIS layers. See also Figure 4.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Directory		<drive>\ingle\avdata\geology	
File system size		12 Mb	
Date of last update		October 1998	
Data custodian		Peter R. Dawes and Peter Appel	
ArcView GIS layers	Legend field	Legend file	Description
fault	Linecode	***fault.avl***	Fault line from scale 1:250 000
geol_l	Linecode	***geol_l.avl***	Outline of geological units scale 1:250 000
geol_p	Geolcode	***geol_p.avl***	Polygon of geological units scale 1:250 000
minturn	Photo	***minturn.avl***	Point of located Minturn circles
trend	Linecode	***trend.avl***	Structure line from scale 1:250 000
fault	110 fault		
geol_l	1 mapframe 5 normal line 10 ice margin 40 lake margin		
geol_p	QUATERNARY 900 Undifferentiated surficial deposits FRANKLINIAN BASIN, mainly Ryder Gletscher Group 800 Middle to Upper Cambrian, carbonates 700 Lower to Middle Cambrian, basal siliciclastics, carbonates THULE BASIN, Thule Supergroup 600 Late Proterozoic siliciclastics (Hadrynian) 500 Middle Proterozoic basaltic sills (Neohelikian) 400 Middle Proterozoic siliciclastics, minor carbonates (Neohelikian) INGLEFIELD MOBILE BELT, Early Proterozoic (? with Archaean) 300 Late granite 200 Etah meta-igneous complex, paragneiss, orthogneiss 100 Etah Group, marble-rich supracrustal rocks Topographic features 60 Kane Basin 40 lakes > 0.200 km^2 20 ice caps on land 10 Inland Ice		
minturn	The Minturn circles are directly linked to photographs, which are placed in the sub-directory **photo**. The hot-link field name is Hot_photo in the attribute table of the GIS layer.		
trend	100 trend		

Table 4. *The upper part of the table contains general information on the sub-directory* **geology** *including the names of the GIS layers and legend file. 'Legend field' shows the attribute table field for adding the ArcView GIS legend file provided in* **geology** *(.avl file, e.g.* ***fault.avl*** *is loaded to attribute table field Linecode in the fault layer). The lower part of the table lists the legend values. See also Figure 6.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

Directory		<drive>\ingle\avdata\geophys	
File system size		6 Mb	
Date of last update		October 1998	
Data custodian		Leif Thorning	
ArcView GIS image and layers	Legend field	Legend or colour file	Description
acdh_cl		***acdh_cl.clr***	Apparent conductivity
ba_class		***ba_class.clr***	Bouguer anomaly
gammaray	Stype	***gammaray.avl***	Total gamma radiation
geotem_p	Ms_m	***geotem_p.avl***	GEOTEM transient EM anomaly with readings in mS/m in attribute ms_s
gravpoin			Points of gravimetric measurement with UTM co-ordinates, altitude in metres, free-air, bouguer, calculated terrain correction and terrain corrected bouguer all in mgal in the attribute table
tfsrcol		***tfsrcol.clr***	Coloured total magnetic intensity with black shaded relief
tfsrgrey			Grey coloured total magnetic intensity with black shaded relief
tf_class		***tf_class.clr***	Coloured total magnetic intensity
vgsrcol		***vgsrcol.clr***	Coloured calculated magnetic vertical gradient with black shaded relief
vgsrgrey			Grey coloured calculated magnetic vertical gradient with black shaded relief
vg_class		***vg_class.clr***	Coloured calculated magnetic vertical gradient
Colour files (.clr files)		Description	
0		Represents NODATA, the colour is white	
1		Shaded relief, if any, the colour is black	
2 – 42		Reclassified values from the original data with corresponding colours	
NODATA		Not used as ArcView GIS always treats NODATA as black colour	

Table 5. *The upper part of the table contains general information on the sub-directory* **geophys** *including the names of the GIS grids with corresponding colour file and the GIS layers with legend file. 'Legend field' shows the attribute field for adding the ArcView GIS legend file. 'Legend or colour file' shows the file names of legend (.avl file, e.g.* ***gamma-ray.avl*** *is loaded to attribute field Stype in the gammaray layer) or the colour file (by adding the grid file in ArcView GIS the colour file is added by default). Both legend files and colour files are provided in* **geophys**. *The grids are all reclassified to numbers between 0 and 42. The lower part of the table lists the definition of a colour file (.clr file). See also Figure 7.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Directory		**<drive>\ingle\avdata\licences**	
File system size		12 kb	
Date of last update		October 1998	
Data custodian		Bjørn Thomassen	
ArcView GIS layers	Legend field	Legend and hot-link file	Description
els155	Sub_area	***els155.avl*** ***ref155.txt***	Exclusive exploration licence no 155
els267	Sub_area	***els267.avl*** ***ref267.txt***	Exclusive exploration licence no 267
els270	Sub_area	***els270.avl*** ***ref270.txt***	Exclusive exploration licence no 270
Attribute fields		Description	
Id		Not used and invisible	
Claim_no		Survey internal claim number	
Sub_area		ArcView GIS legend attribute field	
Hotlink		Hot-link to an ASCII file	

Table 6. *The upper part of the table contains general information on the sub-directory* **licences** *including the names of the GIS layers, legend file and hot-link file. 'Legend field' shows the attribute table field for adding the ArcView GIS legend file (.avl file, e.g. els155.avl is loaded to attribute field Sub_area in the* **els155** *layer). Hot-link files are used within ArcView GIS file (.txt file, e.g. ref155.txt is loaded to attribute table field Hotlink in the* **els155** *layer). Both legend files and hot-link files are provided in* **licences**. *The lower part of the table lists the general description of the attribute table fields of all the GIS layers. See also Figure 8.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Directory		<drive>\ingle\avdata\minocc		
File system size		5 kb		
Date of last update		October 1998		
Data custodian		Mogens Lind		
ArcView GIS name	Legend field	Legend file	Description	
cuznfeau			Mineral occurrences of Cu, Zn, Fe and Au	
fe_sulph			Mineral occurrences of Fe sulphides	
Attribute fields		Description		
Case_sub		Survey internal case and sub-number		
Long		Geographic longitude		
Lat		Geographic latitude		
Host_rock		Host rock:	IGN	= Igneous
			MET	= Metamorphic
			SED	= Sedimentary
Gen_env		Genetic environment	HYD	= Hydrothermal
			MAG	= Magmatic
			SED	= Sedimentary
Morph		Morphology	DIS	= Disseminated
			LEN	= Lenticular
			MAS	= Massive
			STR	= Stratabound
			VEI	= Vein
Resource		Type of resource		= Cu, Au, Zn and Fe
				= Fe sulphides
Mineralogy		Type of mineralogy	OX	= Oxide
			SU	= Sulphide
Eco_imp		Economic importance		= Showing

Table 7. *The upper part of the table contains general information on the sub-directory* **minocc** *including the names of the GIS layers. The lower part of the table lists the general description of the attribute table fields of all the GIS layers. See also Figure 9.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

Directory		**<drive>\ingle\avdata\samples**	
File system size		1 Mb	
Date of last update		October 1998	
Data custodian		Department of Economic Geology	
ArcView GIS layers and table files	Legend field	Legend file	Description
dl.dbf			Detection limit table; 1 row per method
dl_trans.dbf			Detection limit table transposed; 1 column per method
gammaray			Raw data gamma radiation
geochem	Samp_type	***geochem.avl***	Raw data geochemical samples
rock	Analysed	***rock.avl***	Raw data rock samples
rockdesc.dbf			Description of rock samples
ArcView GIS layers and table files		Table reference	
dl.dbf ***dl_trans.dbf***		Table 9	
gammaray		Table 10	
geochem		Table 11	
rock		Table 12	
rockdesc.dbf		Table 13	

Table 8. *The upper part of table contains general information on the sub-directory* **samples** *including the names of the GIS layers and data table files. 'Legend file' shows the column for adding the ArcView GIS legend file (.avl file, e.g. geochem.avl is loaded to column samp_type in the geochem layer). The lower part of the table lists references to 'ArcView GIS layers and table files'. See also Figure 10.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text****.*

Attribute fields of ***dl.dbf***	Description
Headings	The content is used as headings for the transposed version
Lab_code	a....i; each new analysing method defines a new lab_code
Lab	Abbreviation of the laboratory name
Labtext	Full laboratory name
Method	Abbreviation for analysis method
Methodtext	Full text of analysis method
Ana_date	Date of analysis
<u>Element fields:</u> Ag Al As Au B Ba Be Bi Br Ca Cd Ce Co Cr Cs Cu Eu Fe Ga Hf Hg Ir K La Lu Mg Mn Mo Na Nb Nd Ni P Pb Pd Pt Rb Sb Sc Se Sm Sn Sr Ta Tb Th Ti U V W Y Yb Zn Zr	All elements are listed alphabetically and oxides are listed in conventional order Empty cell value denotes not analysed Shows the detection limit of each method
<u>Oxide fields:</u> SiO2 TiO2 Al2O3 Fe2O3* Fe2O3 FeO MnO MgO CaO Na2O K2O P2O5 Loi	Fe2O3* denotes total Fe as Fe_2O_3

Table 9. *Attribute table fields of **dl.dbf** in the sub-directory* **samples**. *The file **dl_trans.dbf** is transposed **dl.dbf**, and has attribute table fields from the content of 'Headings' in file **dl.dbf**. Both files show detection limit of each element and oxide combined to analytical method. See also Figure 10.* **The directories are in bold text**, *GIS layers are in italic text and **file names are in bold italic text**.*

Attribute fields of *gammaray*	Description
Sample_id	Survey internal sample identifier
Longitude	Longitude in decimal degrees
Latitude	Latitude in decimal degrees
Gammaray	Ground scintillometry measurement of total gamma-radiation
Collector	Collectors name
Year	Year of collection

Table 10. *Attribute table fields of GIS layer gammaray in the sub-directory* **samples**. *See also Figure 10.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Attribute fields of *geochem*	Description
Sample_id	Survey internal sample identifier
Samp_type	Sample type; full text see 'Type'
<u>Element fields:</u> Ag As Au Ba Be Bi Br Cd Ce Co Cr Cs Cu Eu Hf La Lu Mo Nd Ni Pb Rb Sb Sc Sm Sr Ta Th U V W Y Yb Zn <u>Oxide fields:</u> SiO2 TiO2 Al2O3 Fe2O3* FeO MnO MgO CaO Na2O K2O P2O5 Loi	All elements are listed alphabetically and oxides are listed in conventional order • empty cell value denotes not analysed • negative cell value denotes below detection limit (the number is the detection limit) • positive cell value denotes the analytical value All elements and oxides are listed here by their native form but in the table in ArcView GIS all have suffixes to indicate unit of measurement and analysing method Unit: ppb = parts per billion (10^9) ppm = parts per million % = per cent Method: a to i placed in parentheses; see Table 9 and ***dl.dbf*** or ***dl_trans.dbf*** E.g.: Ag_ppm(b): element = Ag unit = ppm method = b SiO2_%(c): oxide = SiO_2 unit = % method = c Fe2O3* denotes total Fe as Fe_2O_3
Longitude	Longitude in decimal degrees (negative is west from Greenwich meridian)
Latitude	Latitude in decimal degrees
Type	Full text of 'Samp_type'
Collector	Collectors name
Year	Year of collection

Table 11. *Attribute table fields of GIS layer geochem in the sub-directory* **samples**. *See also Figure 10.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Attribute fields of *rock*	Description
Sample_id	Survey internal sample identifier
Sample_sub	Sample identifier sub-number
Element fields: Ag Al As Au B Ba Be Bi Br Ca Cd Ce Co Cr Cs Cu Eu Fe Ga Hf Hg Ir K La Lu Mg Mn Mo Na Nb Nd Ni P Pb Pd Pt Rb Sb Sc Se Sm Sn Sr Ta Tb Th Ti U V W Y Yb Zn Zr Oxide fields: SiO2 TiO2 Al2O3 Fe2O3* Fe2O3 FeO MnO MgO CaO Na2O K2O P2O5 Loi	All elements are listed alphabetically and oxides are listed in conventional order • empty cell value denotes not analysed • negative cell value denotes below detection limit (the number is the detection limit) • positive cell value denotes the analytical value All elements and oxides are listed here by their native form but in the table in ArcView GIS all have suffixes to indicate unit of measurement and analysing method Unit: ppb = parts per billion (10^9) ppm = parts per million % = per cent Method: a to i placed in parentheses; see Table 9 and dl.dbf or dl_trans.dbf E.g.: Ag_ppm(b): element = Ag unit = ppm method = b SiO2_%(c): oxide = SiO_2 unit = % method = c Fe2O3* denotes total Fe as Fe_2O_3
Comments	
Longitude	Longitude in decimal degrees (negative is west from Greenwich meridian)
Latitude	Latitude in decimal degrees
Collector	Collectors name
Year	Year of collection
Analysed	If sample is analysed by one of the methods (methods a....i) the field is 'Yes' otherwise it is 'No'

Table 12. *Attribute table fields of GIS layer rock in the sub-directory* **samples**. *See also Figure 10.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

Attribute fields of ***rockdesc.dbf***	Description
Sample_id	Survey internal sample identifier
Kind	Kind of sample: rock, mineral or fossil
Analysed	If sample is analysed by one of the methods (methods a....i) the field is 'Yes' otherwise it is 'No'
Type	Type of sample: hand sample, chip, channel, core or large
Weight	Weight in kilogram
Rock_type	Collectors personal description of rock type
Oremineral	Collectors personal description of ore minerals
Purpose	Purpose of collecting the sample
Origin	Presumed origin of sample
Dformation	Deformation: None, Low or High
Dformstyle	Deformation style: Brittle or Ductile
Metamorph	Metamorphism: No, Low or High
Metam_type	Metamorphism type: Regional or Local
Alteration	Alteration: None, Hydrothermal, Unspecified or Unknown
Collector	Collectors name
Year	Year of collection

Table 13. *Attribute table fields of* ***rockdesc.dbf*** in the sub-directory **samples**. *See also Figure 10.* **The directories are in bold text**, *GIS layers are in italic text and* ***file names are in bold italic text***.

The Geological Survey of Denmark and Greenland (GEUS) is a research and advisory institution in the Ministry of Environment and Energy

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