

A GIS compilation of the mineral reconnaissance data, Pituffik region, North-West Greenland

Report prepared for Red Rock Resources

T. M. Rasmussen, M.S. Jørgensen, T. Tukiainen & P. Kalvig

(1 DVD included)



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Introduction

NAMA Greenland Ltd. holds the exploration license no. 2011/25 in the Pituffik/Thule area, and has, in association Red Rock Resources plc, requested GEUS to provide available ASTER data and geological maps of the area of interest, with the aim to provide available data in digital format in order to allow visualisation and analysis in a Geographic Information System (GIS).

This report and enclosed DVD should be regarded as an addendum to the GEUS report by Thomassen and Tukiainen (2009) on geochemical data and geological observations from the Pituffik/Thule area. Additional digital elevation models derived from ASTER data are included on the DVD. Geological information extracted from the One Geology map (preview of present (non-released) GEUS contribution to <http://portal.onegeology.org>, Geological map of Greenland, 1:2.500.000 (Escher & Pulvertaft, 1995), digital version (shape files, 2008) are provided in digital format as a separate GIS project. Information on geological environments reported in Stendal *et al.* (2005) is furthermore added in digital GIS format to the DVD. The included data are described in some details below in separate sections.

Data

ASTER data, topographic contours and digital elevation models

Data acquired by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) were utilized in order to improve the map base for the Pituffik/Thule area. The new Global Digital Elevation Model (GDEM) produced by the Ministry of Economy, Trade and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA) from ASTER optical stereo data was released to the public on June 29, 2009.

ASTER DEM standard data products are produced with 30 m postings, and have vertical precision generally between 10 m and 25 m (root mean square error, RMSE).

The following geo-coded themes/data layers are included:

- False color composite map from ASTER VNIR data; lateral resolution/accuracy 15 x 15 m
- Coastline (sea level) extracted from ASTER VNIR data; lateral resolution 15 x 15 m
- Topographic contours with 50 m contour intervals based on the GDEM
- Digital elevation model (GDEM) re-sampled to 30 x 30 m grids

Screen dumps from the ArcGIS project window with false composite images are shown in Figures 1-3. Screen dumps of coastline data are shown in Figure 4 and the topographic contours are shown in Figure 5. A screen dump of the GDEM is provided in Figure 6.

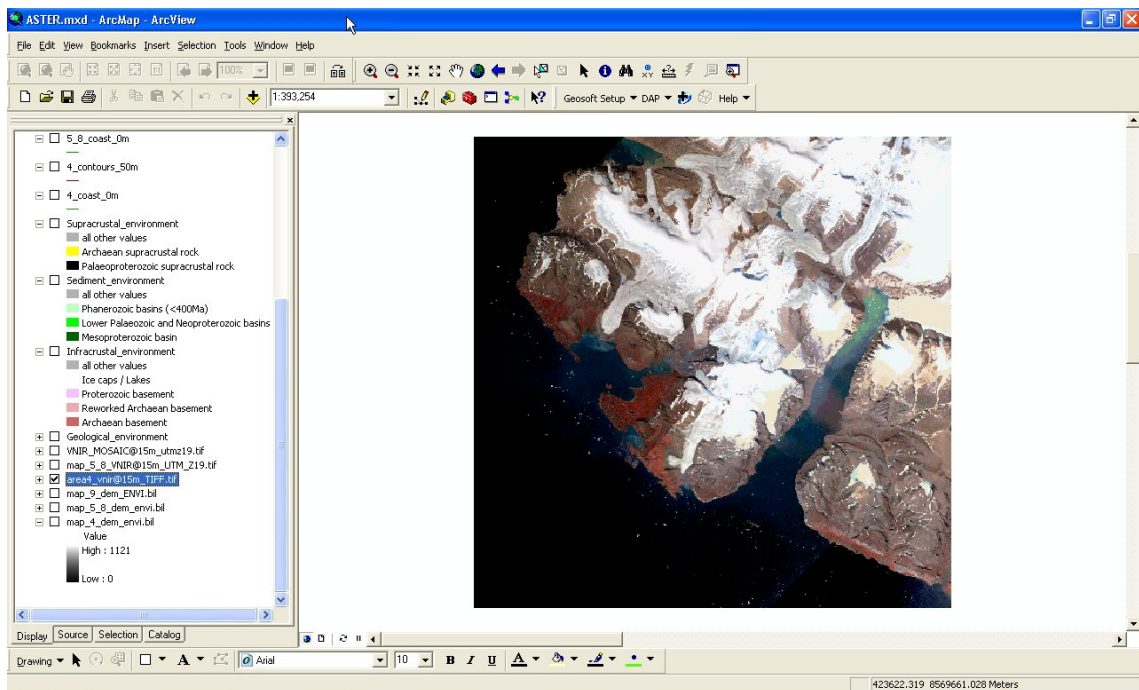


Figure 1. Screen dump of false colour composite image from ASTER VNIR data covering map 4 in Thomassen & Tukiainen (2009).

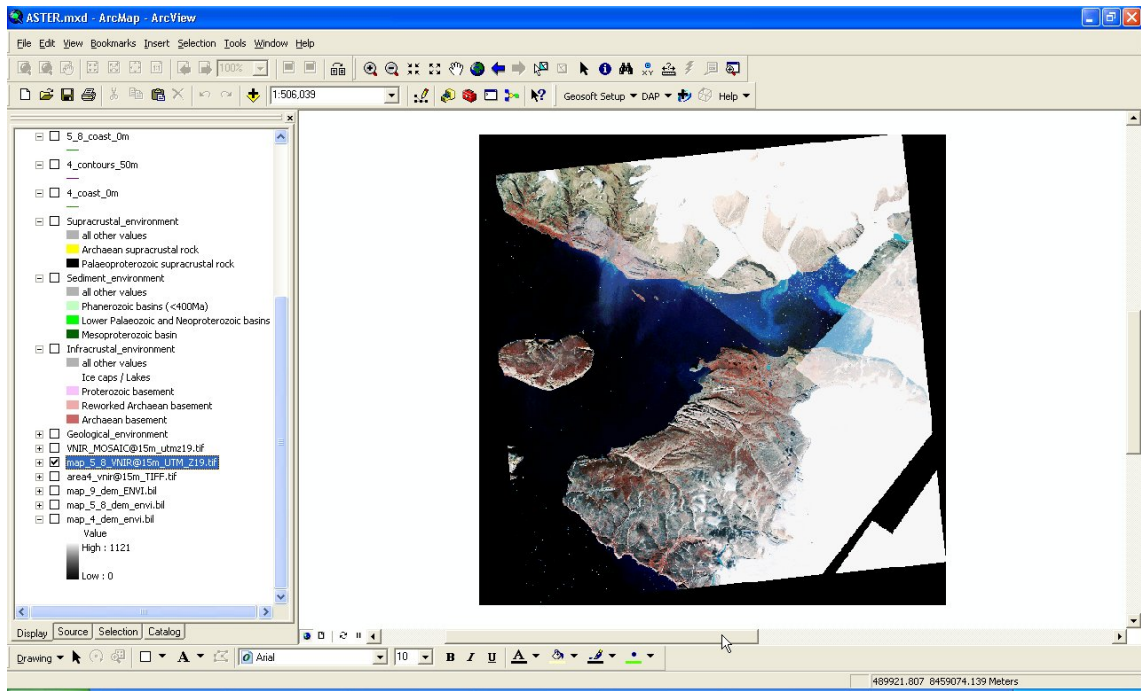


Figure 2. Screen dump of false colour composite image from ASTER VNIR data covering maps 5-8 in Thomassen & Tukiainen (2009).

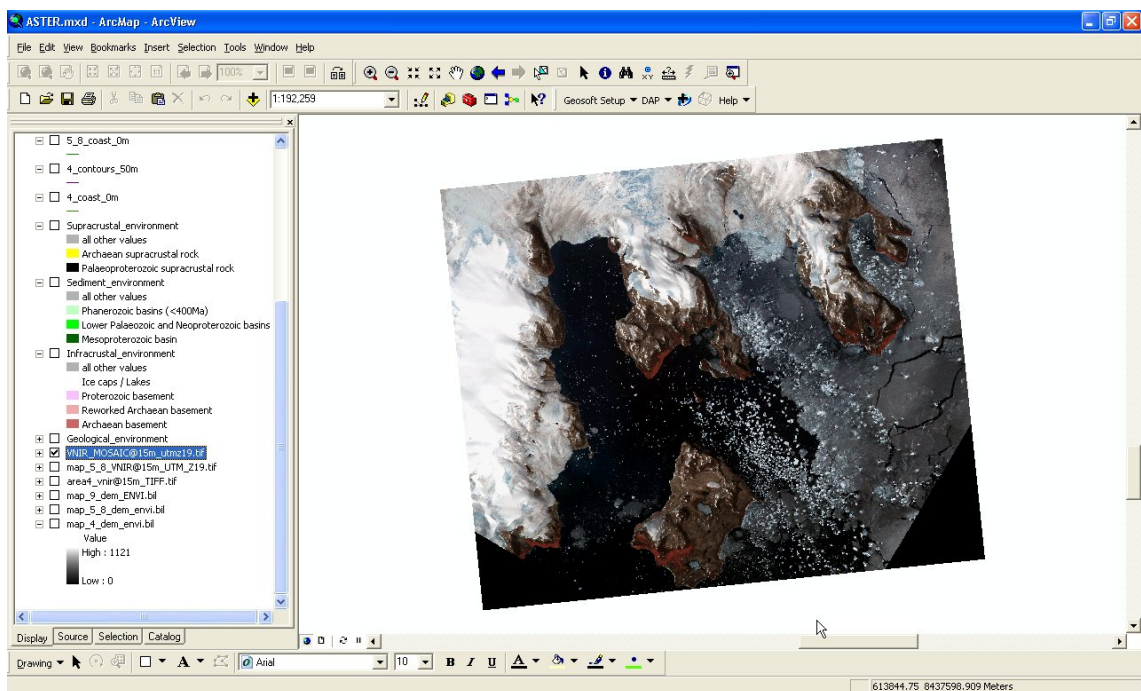


Figure 3. Screen dump of false colour composite image from ASTER VNIR data covering map 9 in Thomassen & Tukiainen (2009).

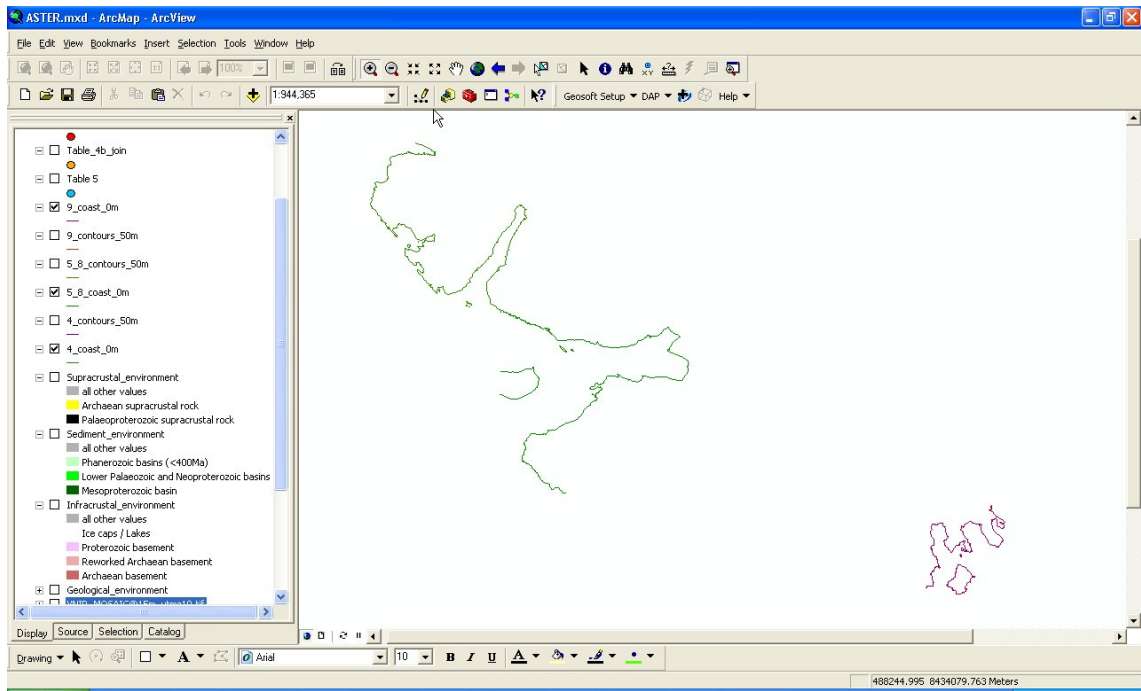


Figure 4. Screen dump of coast line data derived from ASTER VNIR data.

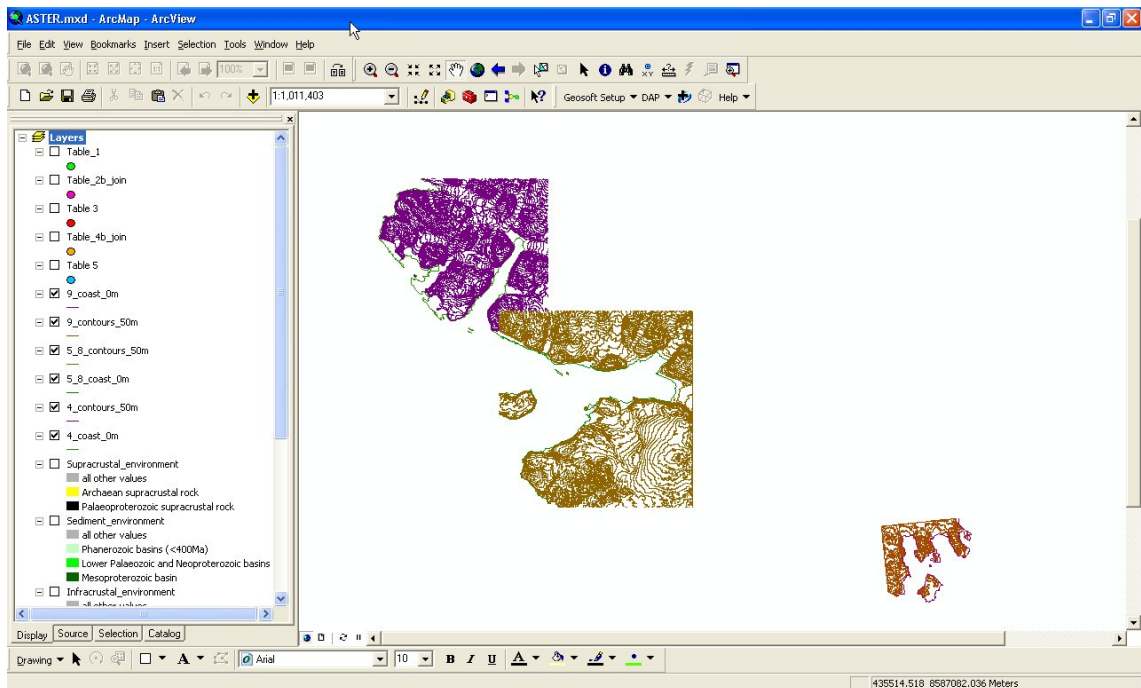


Figure 5. Screen dump showing all topographic contour data.

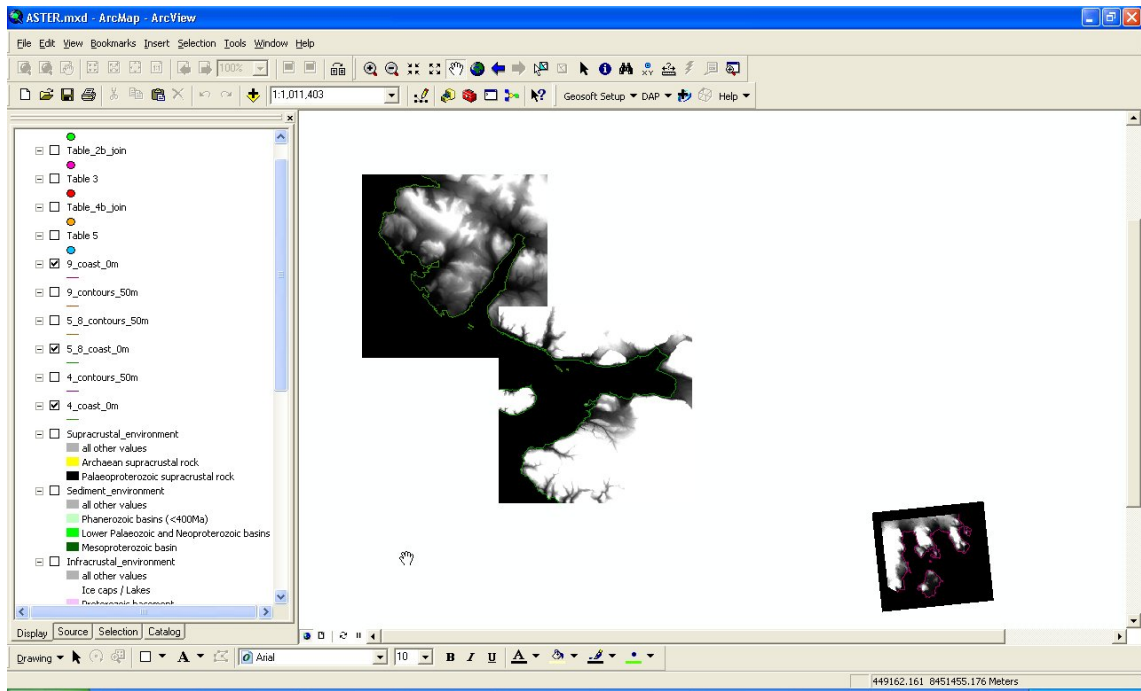


Figure 6. Screen dump of GDEM covering maps 4-9 in Thomassen & Tukiainen (2009).

Geological map in scale 1:2.500.00 and One Geology map

The Geological map of Greenland, 1:2.500.000 (Escher & Pulvertaft, 1995) is provided in digital shapefile format (.SHP) for two separate GIS projects – GmoG_2_5M_dd.MXD and GmoG_2_5.MXD. Both .MXD projects use WGS84/UTM24N for data display. The digital data included are:

- Two georeferenced tagged image files (.TIF) of the printed map sheet and the legend
- Shapefiles corresponding to some of the themes of the printed map sheet
- Display applications for ArcGis and ArcReader (free download from <http://www.esri.com/software/arcgis/arcreader>)

A screen dump of the map presentation in ArcGIS is shown in Figure 7. The map in Figure 7 is identical to the excerpt from the (unofficial) GEUS One Geology contribution. The excerpt provided corresponds to the area of map 1 in Thomassen & Tukiainen (2009). The GEUS contribution expected for the official release of the One Geology map is likely to include more details.

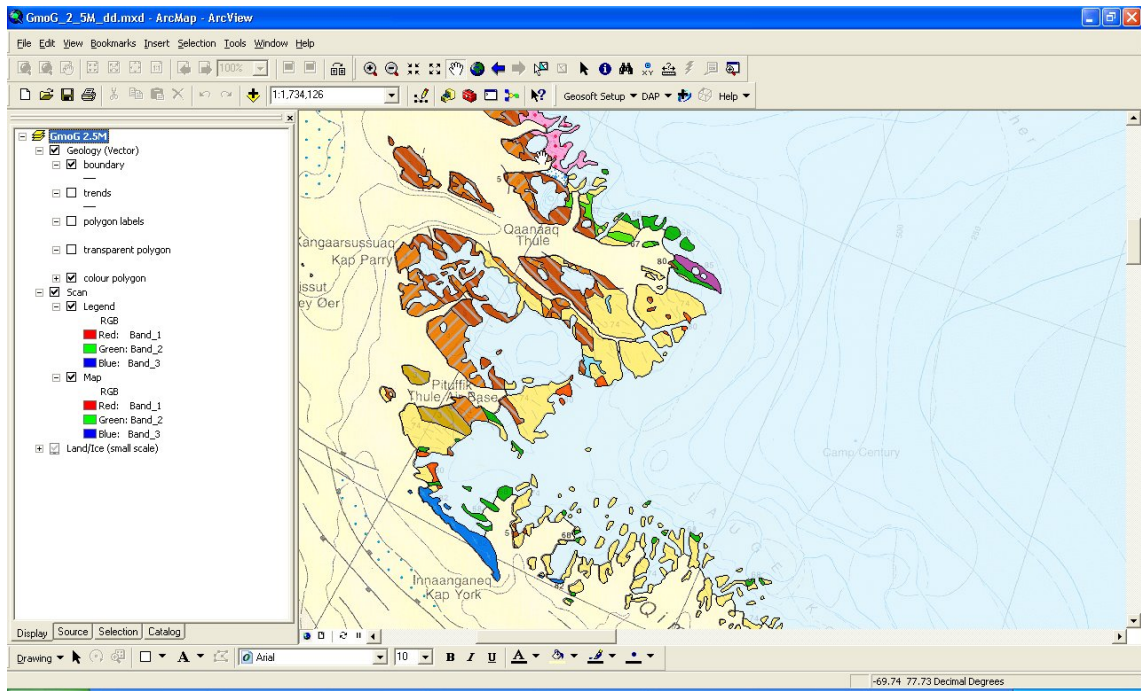


Figure 7. Screen dump showing the geological map in scale 1:2.500.000.

Maps of geological environments

The geological environments outlined by Stendal *et al.* (2005) are included in the ArcGIS project ASTER.MXD and as four separate ArcGIS projects. The figures 8 -11 show screen dumps of the maps. Note that the superimposed coastline derived from the ASTER data on these maps show a significant discrepancy with respect to the base map used for the display of the geological environments.

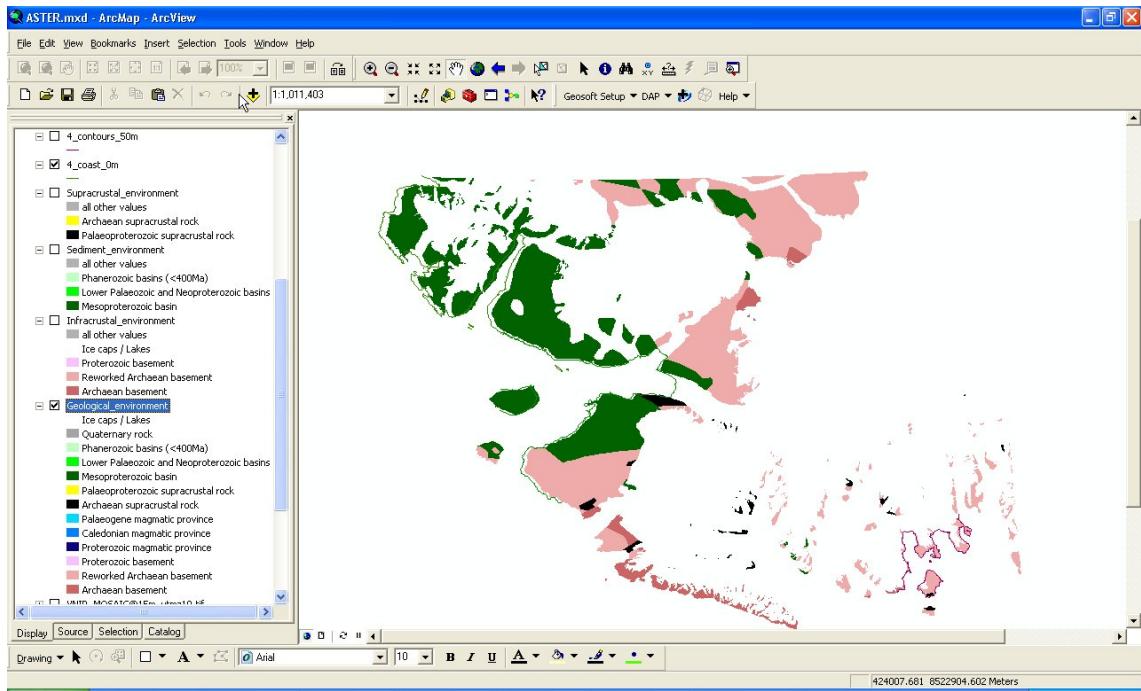


Figure 8. Screen dump showing the geological environment as defined in Stendal et al. (2005). Coast lines derived from ASTER data are superimposed.

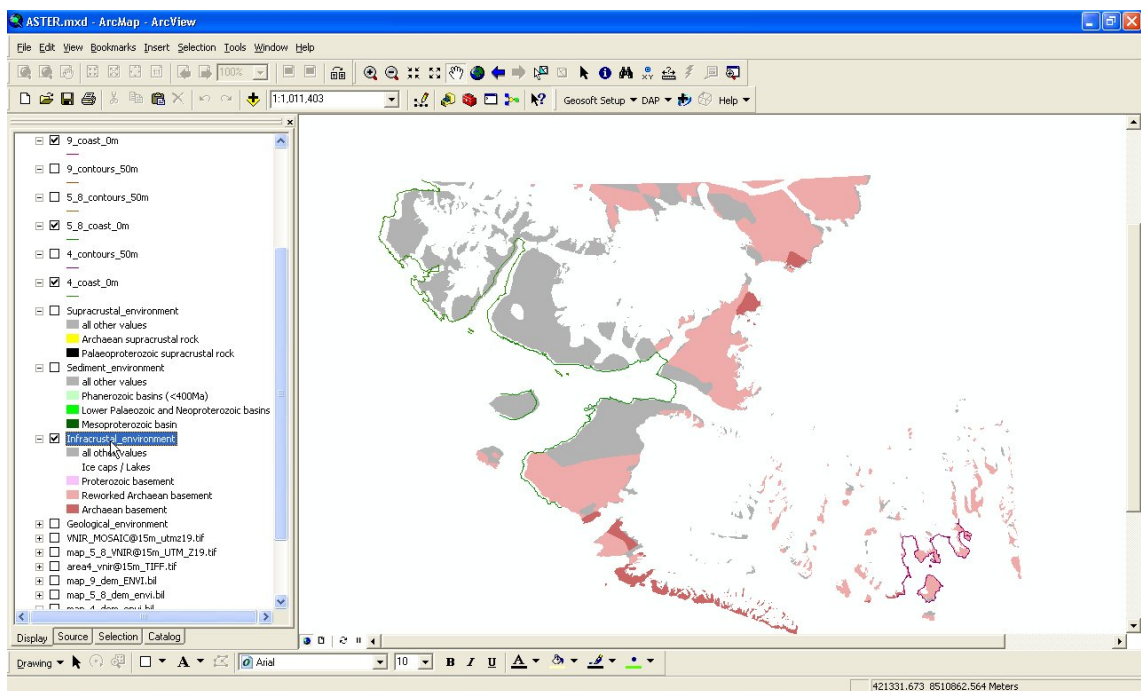


Figure 9. Screen dump showing the infracrustal environment as defined in Stendal et al. (2005). Coast lines derived from ASTER data are superimposed.

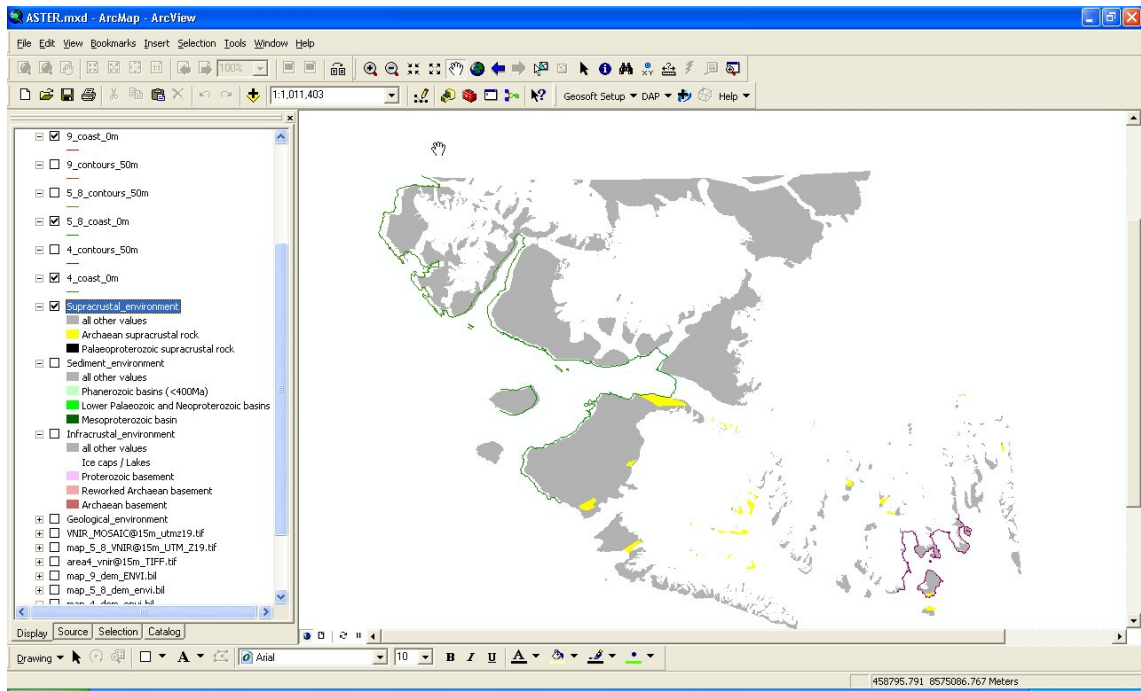


Figure 10. Screen dump showing the supracrustal environment as defined in Stendal et al. (2005). Coast lines derived from ASTER data are superimposed.

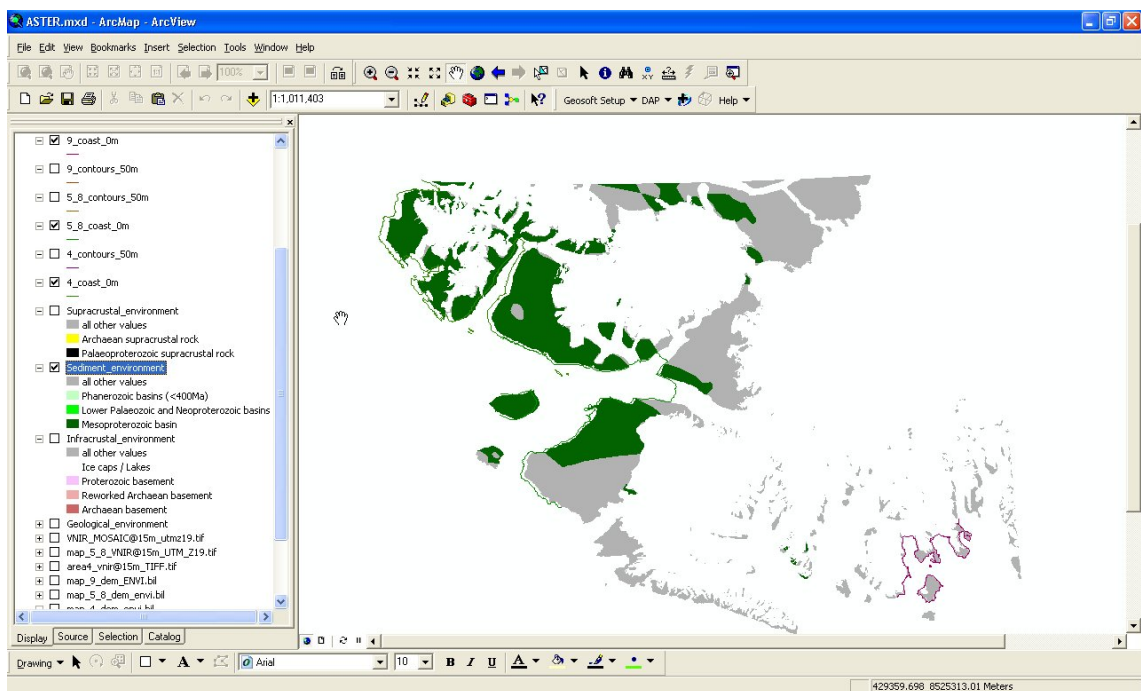


Figure 11. Screen dump showing the sediment environments as defined in Stendal et al. (2005). Coast lines derived from ASTER data are superimposed.

Tabulated data in the report by Thomassen & Tukiainen (2009)

The screen dumps in the figures 12–14 show the sample locations of data in Tables 1, 3 & 5 as given by Thomassen & Tukiainen (2009). The data in tables 2b and 5b have been geo-referenced and are include on the accompanying DVD.

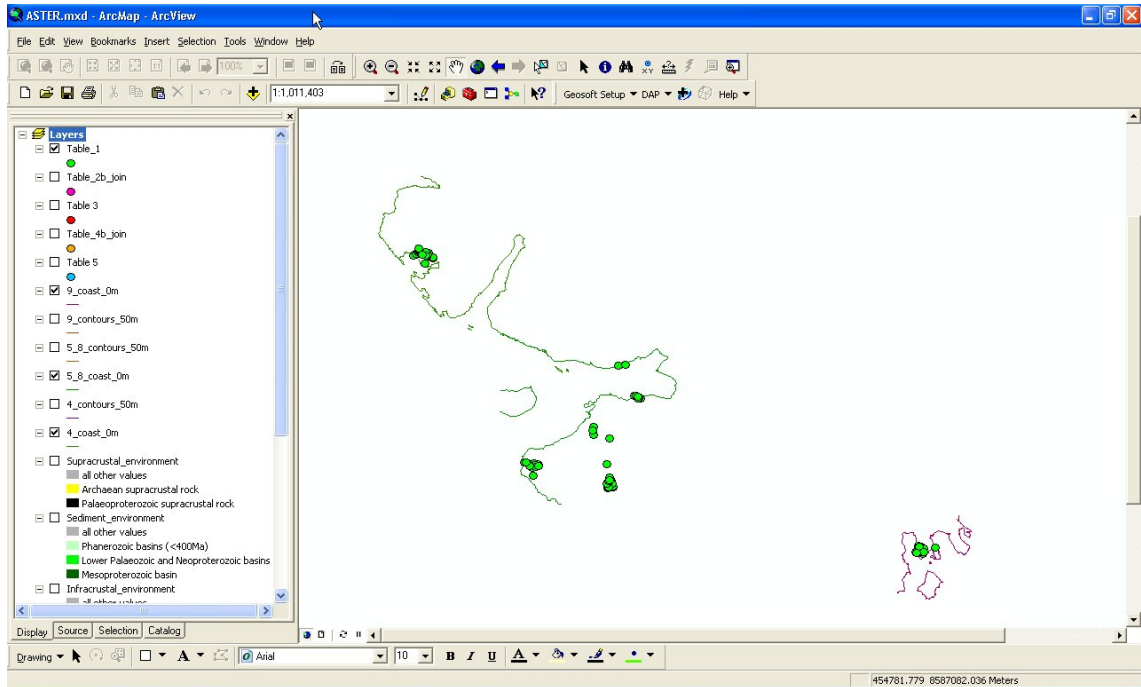


Figure 12. Sample location corresponding to data in Table 1 in Thomassen & Tukiainen (2009). Data are provided on the DVD in shapefile format, Microsoft Excel .XLS format and as comma separated files.

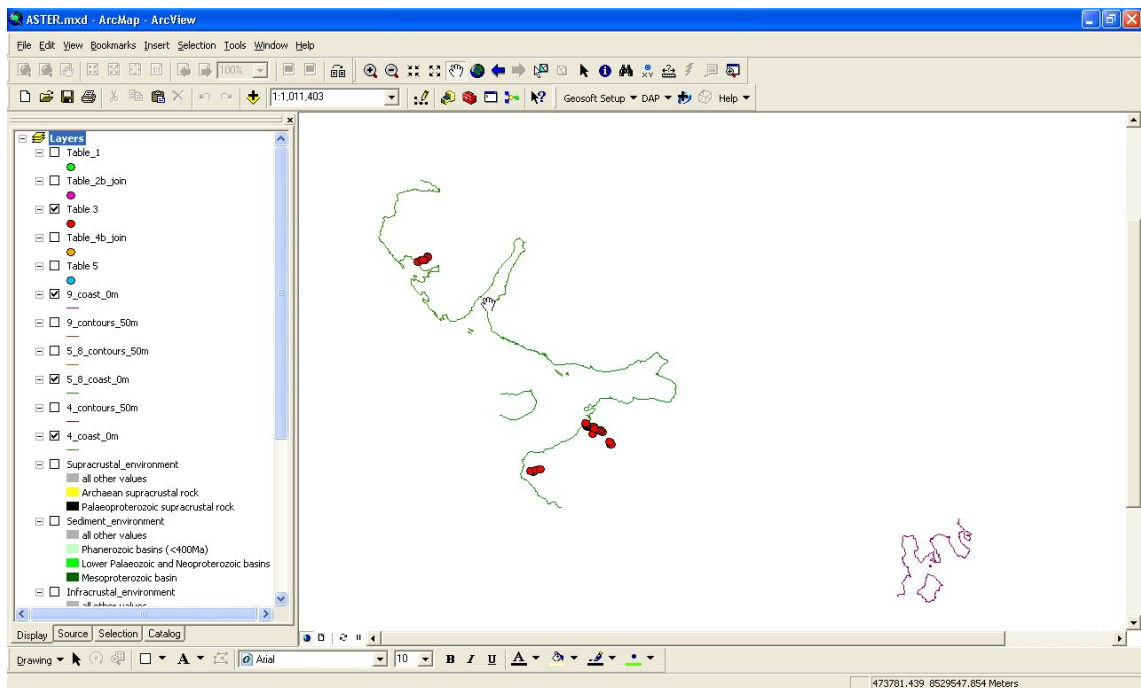


Figure 13. Sample location corresponding to data in Table 3 in Thomassen & Tukiainen (2009). Data are provided on the DVD in shapefile format, Microsoft Excel .XLS format and as comma separated files.

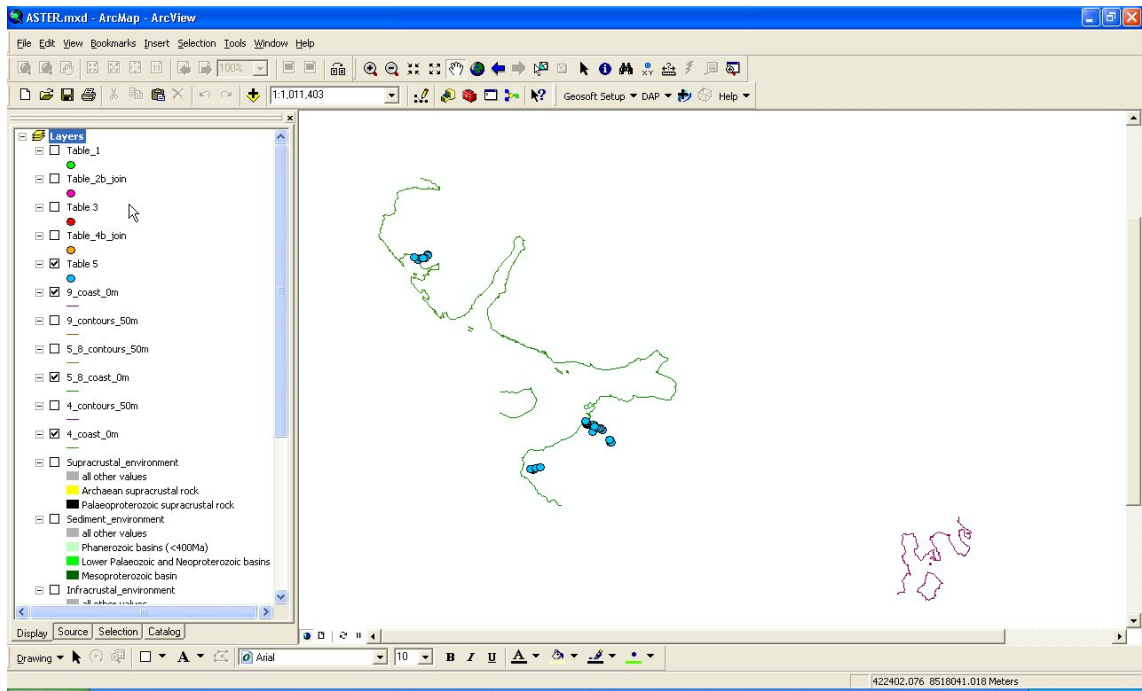


Figure 14. Sample location corresponding to data in Table 5 in Thomassen & Tukiainen (2009). Data are provided on the DVD in shapefile format, Microsoft Excel .XLS format and as comma separated files.

Content of DVD and data format

The directory structure of the DVD is displayed in Figure 15. Three directories with tabulated data from the report by Thomassen & Tukiainen (2009) are provided. The original tables have been reformatted for easy import into a GIS project. The tables are provided in both shapfile format, Microsoft Excel .XLS format and as comma-separated files. Eight ArcGIS .MXD project files are included in the subdirectories located within directory ArcGIS. The ArcGIS .MXD filenames and directories are shown in Figure 16. A complete list of directories and filename are included in Appendix.

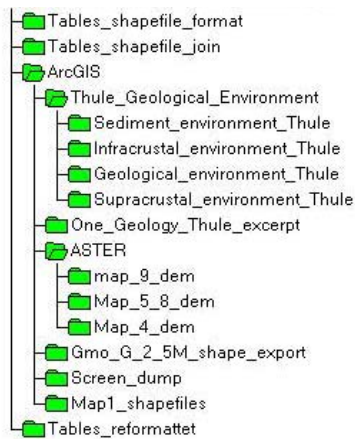


Figure 15. Directory list of the DVD

Supracrustal_environment_Thule.mxd	ArcGIS/Thule_Geological_Environment/Supracrustal_environment_Thule
Geological_environment.mxd	ArcGIS/Thule_Geological_Environment/Geological_environment_Thule
Infracrustal_environment_Thule.mxd	ArcGIS/Thule_Geological_Environment/Infracrustal_environment_Thule
Sediment_environment_Thule.mxd	ArcGIS/Thule_Geological_Environment/Sediment_environment_Thule
GmoG_2_5M_dd.mxd	ArcGIS/Gmo_G_2_5M_shape_export
GmoG_2_5M.mxd	ArcGIS/Gmo_G_2_5M_shape_export
ASTER.mxd	ArcGIS/ASTER
GmoG_2_5M.mxd	ArcGIS/One_Geology_Thule_excerpt

Figure 16. List of ArcGIS .MXD project files and associated directories

Geographic location accuracy

The data provided are derived from sources of different scale, accuracy and precision. For example the digital elevation model derived from the ASTER data has a lateral resolution/accuracy of 15 m and 30 m, whereas the geological map from the One Geology data source is based on maps in scale 1: 2.500.000; i.e. roughly an order of magnitude or more in terms of difference in accuracy. Some of the older geological observations made prior to the introduction of GPS are furthermore subject to lack of precision. The data are therefore not fully compatible geographically if joined into a common GIS-project.

Maps 1 and 4-9 in Thomassen and Tukiainen (2009) show sample locations and locations of rivers superimposed on a topographic basemap with height contours. The basemap is of low spatial accuracy and sample positions located from GPS were not displayed properly on this basemap unless shifted laterally. The basemap was initially utilised for maps in scale 1:250.000, but the accuracy ("systematic shift") was not fully adequate for this scale in this particular region. Some of the samples are from fieldwork prior to the introduction of GPS and geo-referenced visually to the basemap. Adjustments were applied to some of the sample locations (samples located by GPS) when these maps were produced for the report by Thomassen & Tukiainen (2009). The maps should therefore be used with some precaution and field work should be based on the GPS data whenever possible and by using more accurate topographic information. The discrepancy between different data sets is exemplified in Figures 8–11, where ASTER derived coastlines are superimposed on maps using the 1:250.000 basemap for display of geological environments.

The topographic information derived from ASTER data has an accuracy of about 30 m laterally and the maps provided on the DVD are based on this accuracy. No shift of GPS derived coordinates has been applied.

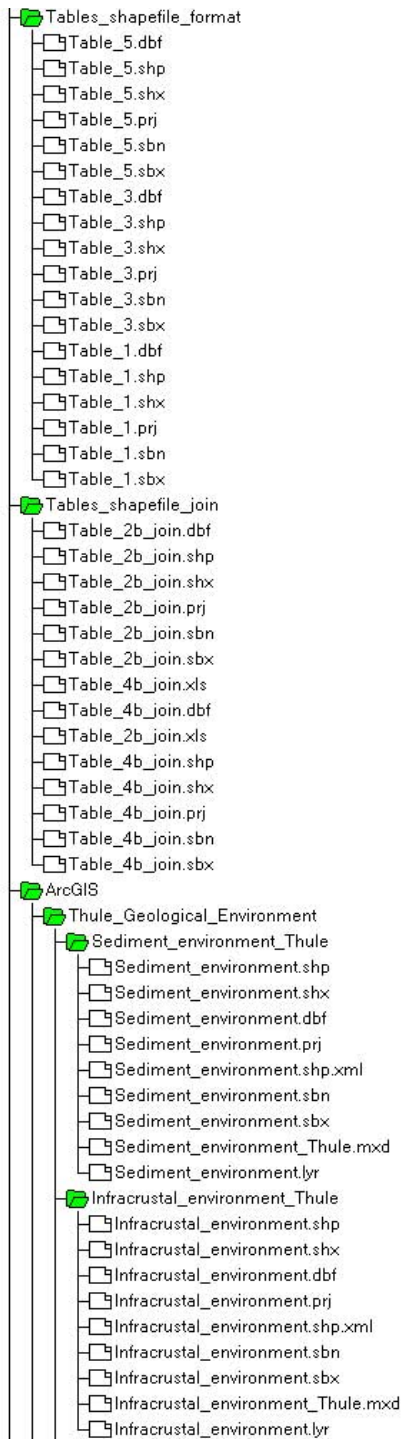
References

Escher, J.C. & Pulvertaft, T.C.R. 1995: Geological map of Greenland, 1:2 500 000. Copenhagen: Geological Survey of Greenland.

Stendal, H., Secher, K., Nielsen, B.M., Schønwandt, H.K. & Thorning, L. 2005: Greenland geological environments and mineral resources. Danmarks og Grønlands Geologiske Undersøgelse Rapport **2005/8**, 211 pp.

Thomassen, B. & Tukiainen, T. 2009: Pituffik 2007: mineral reconnaissance in the Pituffik region, North-West Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport **2009/39**, 116 pp.

Appendix – directory and file listing



- Geological_environment_Thule
 - Geological_environment.shp
 - Geological_environment.shx
 - Geological_environment.dbf
 - Geological_environment.prj
 - Geological_environment.shp.xml
 - Geological_environment.sbn
 - Geological_environment.sbx
 - Geological_environment.mxd
 - Geological_environment.lyr
- Supracrustal_environment_Thule
 - Supracrustal_environment.shp
 - Supracrustal_environment.shx
 - Supracrustal_environment.dbf
 - Supracrustal_environment.prj
 - Supracrustal_environment.shp.xml
 - Supracrustal_environment.sbn
 - Supracrustal_environment.sbx
 - Supracrustal_environment_Thule.mxd
 - Supracrustal_environment.lyr
- One_Geology_Thule_excerpt
 - GmoG_2_5M.mxd
 - GMOG_2_5_DD_Thule.shp
 - GMOG_2_5_DD_Thule.shx
 - GMOG_2_5_DD_Thule.dbf
 - GMOG_2_5_DD_Thule.prj
 - GMOG_2_5_DD_Thule.shp.xml
 - GMOG_2_5_DD_Thule.sbn
 - GMOG_2_5_DD_Thule.sbx
- ASTER
 - map_9_dem
 - map_9_dem_ENVI.bil
 - map_9_dem_ENVI.hdr
 - map_9_dem_ENVI.stx
 - map_9_dem_ENVI.aux
 - map_9_dem_ENVI.rrd
 - map_9_dem_ENVI.bil.aux.xml
 - map_9_dem_ENVI.prj
 - map_9_dem_ENVI.bil.vat.dbf
 - map_9_dem_ENVI.bil.xml
 - Map_5_8_dem
 - map_5_8_dem_envi.bil
 - map_5_8_dem_envi.hdr
 - map_5_8_dem_envi.stx
 - map_5_8_dem_envi.aux
 - map_5_8_dem_envi.rrd
 - map_5_8_dem_envi.bil.aux.xml
 - map_5_8_dem_envi.bil.vat.dbf
 - map_5_8_dem_envi.prj
 - map_5_8_dem_envi.bil.xml
 - Map_4_dem
 - map_4_dem_envi.bil
 - map_4_dem_envi.hdr
 - map_4_dem_envi.stx
 - map_4_dem_envi.aux
 - map_4_dem_envi.rrd
 - map_4_dem_envi.bil.aux.xml

- └─┬─┐map_4_dem_envi.prj
- └─┬─┐4_coast_0m.dbf
- └─┬─┐4_coast_0m.sbn
- └─┬─┐4_coast_0m.sbx
- └─┬─┐4_coast_0m.shp
- └─┬─┐4_coast_0m.shx
- └─┬─┐4_contours_50m.dbf
- └─┬─┐4_contours_50m.sbn
- └─┬─┐4_contours_50m.sbx
- └─┬─┐4_contours_50m.shp
- └─┬─┐4_contours_50m.shx
- └─┬─┐5_8_coast_0m.dbf
- └─┬─┐5_8_coast_0m.sbn
- └─┬─┐5_8_coast_0m.sbx
- └─┬─┐5_8_coast_0m.shp
- └─┬─┐5_8_coast_0m.shx
- └─┬─┐5_8_contours_50m.dbf
- └─┬─┐5_8_contours_50m.sbn
- └─┬─┐5_8_contours_50m.sbx
- └─┬─┐5_8_contours_50m.shp
- └─┬─┐5_8_contours_50m.shx
- └─┬─┐9_coast_0m.dbf
- └─┬─┐9_coast_0m.prj
- └─┬─┐9_coast_0m.sbn
- └─┬─┐9_coast_0m.sbx
- └─┬─┐9_coast_0m.shp
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- └─┬─┐9_contours.sbx
- └─┬─┐9_contours.shp
- └─┬─┐9_contours.shx
- └─┬─┐9_contours_50m.dbf
- └─┬─┐9_contours_50m.prj
- └─┬─┐9_contours_50m.sbn
- └─┬─┐9_contours_50m.sbx
- └─┬─┐9_contours_50m.shp
- └─┬─┐9_contours_50m.shx
- └─┬─┐area4_dem
- └─┬─┐area4_dem.hdr
- └─┬─┐area4_vnir@15m_pyramid
- └─┬─┐area4_vnir@15m_TIFF.aux
- └─┬─┐area4_vnir@15m_TIFF.rrd
- └─┬─┐area4_vnir@15m_TIFF.tfw
- └─┬─┐area4_vnir@15m_TIFF.tif
- └─┬─┐ASTER.mxd
- └─┬─┐map_5_8_VNIR@15m_UTM_Z19.aux
- └─┬─┐map_5_8_VNIR@15m_UTM_Z19.rrd
- └─┬─┐map_5_8_VNIR@15m_UTM_Z19.tfw
- └─┬─┐map_5_8_VNIR@15m_UTM_Z19.tif
- └─┬─┐VNIR_MOSAIC@15m_utmz19.aux
- └─┬─┐VNIR_MOSAIC@15m_utmz19.tfw
- └─┬─┐VNIR_MOSAIC@15m_utmz19.tif
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- └─┬─┐map_9_dem_ENVI.hdr
- └─┬─┐map_5_8_dem_envi
- └─┬─┐map_5_8_dem_envi.hdr

- map_4_dem_enwi
- map_4_dem_enwi.hdr
- GmoG_2_5M_shape_export
 - GmoG_2_5M.mxd
 - GmoG_2_5M.pmf
 - Map_400.tif.gi
 - GmoG_2_5M_dd.mxd
 - GmoG_2_5M_geo.pmf
 - Legend_400.aux
 - Legend_400.rrd
 - Legend_400.tif
 - Legend_400.tif.xml
 - Map_400.aux
 - Map_400.rrd
 - Map_400.tif
 - Map_400.tif.xml
 - TermsOfDelivery.doc
- areas_arc.dbf
- areas_arc.prj
- areas_arc.sbn
- areas_arc.sbx
- areas_arc.shp
- areas_arc.shp.xml
- areas_arc.shx
- areas_p_20m.dbf
- areas_p_20m.prj
- areas_p_20m.sbn
- areas_p_20m.sbx
- areas_p_20m.shp
- areas_p_20m.shp.xml
- areas_p_20m.shx
- colour polygon.lyr
- geology_a.dbf
- geology_a.prj
- geology_a.sbn
- geology_a.sbx
- geology_a.shp
- geology_a.shp.xml
- geology_a.shx
- geology_p.dbf
- geology_p.prj
- geology_p.sbn
- geology_p.sbx
- geology_p.shp
- geology_p.shp.xml
- geology_p.shx
- readme.txt
- schema.ini
- trends.dbf
- trends.prj
- trends.sbn
- trends.sbx
- trends.shp
- trends.shp.xml
- trends.shx
- Screen_dump
- Table_1.jpg

- Table_2b_join.jpg
- Table_3.jpg
- Table_4b_join.jpg
- Table_5.jpg
- contours.jpg
- Supracrustal_environment.jpg
- Sediment_environment.jpg
- Infracrustal_environment.jpg
- Geological_environment.jpg
- VNIR_MOSAIC@15m_utmz19.tif.jpg
- VNIR_5_8_MOSAIC@15m_utmz19.tif.jpg
- area4_VNIR_@15m_tiff.jpg
- map_9_dem_ENVI.jpg
- map_5_8_dem_ENVI.jpg
- map_4_dem_ENVI.jpg
- Map1_shapefiles
 - pitu_coa_p.prj
 - pitu_coa_p.sbn
 - pitu_coa_p.sbx
 - pitu_coa_p.shp
 - pitu_coa_p.shx
 - pitu_lake_l.dbf
 - pitu_lake_l.prj
 - pitu_lake_l.sbn
 - pitu_lake_l.sbx
 - pitu_lake_l.shp
 - pitu_lake_l.shx
 - pitu_lake_p.dbf
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 - pitu_lake_p.sbn
 - pitu_lake_p.sbx
 - pitu_lake_p.shp
 - pitu_lake_p.shx
 - pitu_riv.dbf
 - pitu_riv.prj
 - pitu_riv.sbn
 - pitu_riv.sbx
 - pitu_riv.shp
 - pitu_riv.shx
 - pitunet.dbf
 - pitunet.prj
 - pitunet.sbn
 - pitunet.sbx
 - pitunet.shp
 - pitunet.shx
 - pitu_coa_l.dbf
 - pitu_coa_l.prj
 - pitu_coa_l.sbn
 - pitu_coa_l.sbx
 - pitu_coa_l.shp
 - pitu_coa_l.shx
 - pitu_coa_p.dbf
 - pitu_coa_l.shp.GeosoftMeta
- ArcGIS_projectfiles.jpg
- Thumbs.db
- Tables_reformattet
 - Table_1_Pituffik_2007.csv

- Table_1_Pituffik_2007.xls
- Table_2A_Pituffik_2007.csv
- Table_2A_Pituffik_2007.xls
- Table_2b_Pituffik_2007.csv
- Table_2b_Pituffik_2007.XLS
- Table_3_Pituffik_2007.csv
- Table_3_Pituffik_2007.xls
- Table_4a_Pituffik_2007.csv
- Table_4a_Pituffik_2007.xls
- Table_4b_Pituffik_2007.csv
- Table_4b_Pituffik_2007.xls
- Table_5_Pituffik_2007.csv
- Table_5_Pituffik_2007.xls
- table_6a_pituffik_2007.csv
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- Table_6b_Pituffik_2007.csv
- Table_6b_Pituffik_2007.XLS
- Table_7_Pituffik_2007.xls
- Table_8_Pituffik_2007.xls
- Table_1_Pituffik_2007_DOS.txt.csv
- Table_2b_Pituffik_2007_reformat.XLS
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- Table_2b_join.xls