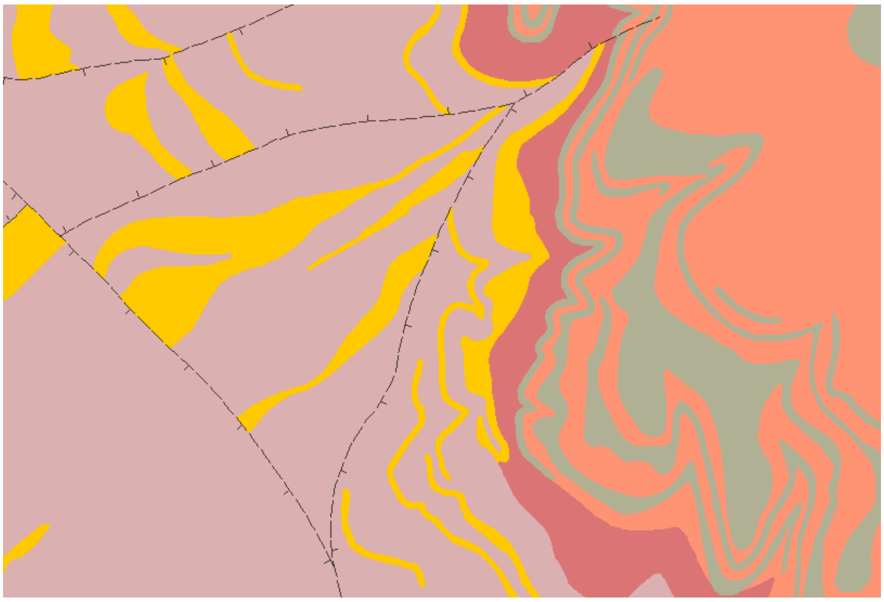
Digital Geological Map of Great Britain, information notes, 2013

Geoscience Products and Services Directorate

Open Report OR/13/007



BRITISH GEOLOGICAL SURVEY

GEOSCIENCE PRODUCTS AND SERVICES DIRECTORATE

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Digital Geological Map of Great Britain, information notes, 2013

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Front cover

Part of new Coalville (EW155) DiGMapGB-50 digital tile showing bedrock and faults

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BRITISH GEOLOGICAL SURVEY

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We publish an annual catalogue of our maps and other publications; this catalogue is available online or from any of the BGS shops.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.

The British Geological Survey is a component body of the Natural Environment Research Council.

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Foreword

The British Geological Survey provides nationwide digital geological maps as DiGMapGB (**Di**gital **G**eological **Map** of **G**reat **B**ritain) datasets at a range of scales. This report is written for users of this digital map data in geographic information systems (GIS). A basic appreciation of geological terminology is needed to understand some of the principles outlined here but users need not be specialists.
This report is available at: http://www.bgs.ac.uk/products/digitalmaps/dataInfo.html.

Acknowledgements

The author would like to thank the many individuals in BGS including geologists and GIS experts in Geoscience Products and Services who have helped create, maintain and update the various DiGMapGB datasets and have contributed comments and suggestions to this report and its many previous versions as hardcopy notes, web pages and pdf downloads.

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Summary

This report is produced by the British Geological Survey's Digital Geological Map of Great Britain (DiGMapGB) team which is responsible for providing digital geological map data at a range of scales. It provides general information relevant to users of all scales of DiGMapGB data arranged into four main chapters.

First, after an introduction, the DiGMapGB datasets are identified and the polygon and linear themes, and their availability, outlined.

Secondly, technical details including the sources, data structure and the information fields attached to polygons and linear features are described together with guidance on data use.

Thirdly, some geological background information is provided especially for non-geologists unfamiliar with map making and some of the basic principles of geology that relate to how the data are structured and can be used.

Fourthly, copyright and licensing information together with explanations of how the datasets are identified and referred to, are provided. The main contacts in BGS are listed.

This is followed by a brief glossary, references and list of web links.

Six appendices provide additional notes for different DiGMapGB datasets and finally the development of digital geological mapping and DiGMapGB data in BGS are summarised.

1 DiGMapGB data

1.1 INTRODUCTION

These information notes are intended for users of Digital Geological Map of Great Britain (DiGMapGB) data in geographic information systems (GIS). They are designed for both geologists and non-geologists, and comprise general notes (applicable to all scales of DiGMapGB data) with additional notes, as appendices, referring to specific datasets.

Geological maps are the foundation for many types of work. They are of potential use to a wide range of customers with economic interests in planning and development, oil and gas (including shale gas) reserves, water and mineral resources, waste disposal sites, utilities, transport, geohazards and property insurance; as well as more academic aspects such as the Earth's geological history, its fossils, and its landscape development.

The British Geological Survey prepares DiGMapGB data at a range of scales from 1:10 000 to 1:625 000. These datasets are available as vector data in a variety of formats in which they are structured into themes primarily for use in geographical information systems (GIS), where they can be integrated with other types of spatial data for analysis and problem solving in many earth-science-related issues.
Limited attribute versions of the 1:50 000 and 1:625 000 scale data may be seen using the map viewers or the web map services (WMS) available at:
http://www.bgs.ac.uk/data/mapViewers/msdviewers.html and
http://www.bgs.ac.uk/data/services/wms.html. They can also be accessed via http://www.bgs.ac.uk/opengeoscience/home.html. This material can be used for free for both commercial and non-commercial purposes under the Open Government Licence subject to the following acknowledgement accompanying the reproduced BGS materials: "Contains British Geological Survey materials © NERC [year]". The terms of use for every product under OpenGeoscience are displayed clearly at the top of every web page including the data downloads page at: http://www.bgs.ac.uk/opengeoscience/downloads.html. The BGS GeoIndex at http://www.bgs.ac.uk/GeoIndex/ also displays the data.

The vector digital maps (or tiles of DiGMapGB digital data) are based on published BGS printed paper maps known as 'geological map sheets'. The digital tiles may now differ from the original paper maps for a number of reasons, for example: digital data modified to improve the fit between tiles; nomenclature updated to current usage; errors on printed maps corrected; and additional geological interpretations made to fill gaps in information. The paper maps (complete with key and other marginalia) used as sources of information are also available as raster images if required; contact Digital Data for more information.

The data comprise primarily polygons (or areas) and lines. Each polygon is attributed with information based on the name (often lithostratigraphical) of the unit and its lithology or composition. These polygons are arranged in up to four themes, as available:

Bedrock theme – for the bedrock (formerly 'solid') geology
Superficial theme – for the superficial (formerly 'drift') or Quaternary deposits
Mass Movement theme – for ground affected by mass movement, mostly landslides
Artificial theme – for the artificially modified, anthropogenic or man-made ground

The lines, held in the Linear theme, include thin beds (such as coal seams and fossil bands), faults, mineral veins and some landforms.

Point data such as dips and strikes, are being captured for 1:10 000 and 1:25 000 scale data, and will be made available in the future.

Work continues to extend the geographical coverage of digital data and to improve the information embedded in the data.

1.2 DIGMAPGB DATASETS

There are four main onshore digital geological map datasets at 1:625 000, 1:250 000, 1:50 000 and 1:10 000 scales (Table 1). In addition there are some tiles at 1:25 000 scale, which substitutes for, or may supplement, the 1:10 000 data in selected areas.

Download a sample of 1:50 000 DiGMapGB data in ESRI® shp files or MapInfo® tab format at: http://www.bgs.ac.uk/downloads/browse.cfm?sec=6&cat=12

Table 1 The main DiGMapGB datasets.

SCALE	DATASET	LATEST VERSION	COMMENT
1:10 000	DiGMapGB-10	V2	In progress, work continues to approve all the data captured and to extend the coverage
1:25 000	DiGMapGB-25	V2	In progress, partial dataset which mostly substitutes for 1:10 000 scale, in selected areas
1:50 000	DiGMapGB-50	V7	Complete except for parts of Wales, (for which either 1:250 000 Bedrock or 1:625 000 Superficial data are available). Includes a few tiles based on 1:100 000 scale maps for Orkneys and Western Isles (Outer Hebrides)
1:250 000	DiGMapGB-250	V4	Complete but essentially out-of-date with no systematic revision since creation
1:625 000	DiGMapGB-625	V5	Bedrock theme released 2008 (as used for fifth edition of printed map); new provisional Superficial data created 2010; Bedrock re-released with revised attribution including unique identifiers
1:625 000	DiGMapGB-625	In preparation	Superficial theme to be released 2013 (created primarily from DiGMapGB-50 data by simplification, with addition of other data in parts)

[Offshore digital geological datasets at 1:250 000 scale for the Bedrock (DigRock250), and Sea bed Sediments (DigSBS250) themes, as well as Bathymetry (DigBath250) are also available.]

1.3 GEOLOGICAL POLYGON (AREA) THEMES

The digital geological maps typically show up to four polygon themes (Table 2).

Table 2 DiGMapGB geological polygon themes.

THEME	COMMENT	AGE
Artificial	Recent anthropogenic or artificially modified ground; man-made or artificial deposits, mineral workings, re-modelled or altered ground	Quaternary age, younger than about 2.6 million years
Mass Movement	Primarily landslide or foundered ground, moved down slope under gravity	
Superficial	Unconsolidated natural in situ superficial or surficial deposits; formerly called 'drift'	
Bedrock	Mostly consolidated natural rocks; formerly called 'Solid'	Pre-Quaternary age, older than about 2.6 million years

1.3.1 Artificial theme

Artificially Modified Ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Whilst artificial or man-made ground is not part of the natural geology of bedrock and superficial deposits it does affect them and needs recording because the near-surface ground conditions are so important to human activities and economic development, including the regeneration of urban areas. This anthropogenic activity often produces unnatural topographic features that need to be distinguished from natural ones to ensure the geological interpretation is ‘correct’.

For DiGMapGB and related purposes, man-made ground information is placed in the Artificial theme. It may sometimes be regarded, in other uses in BGS and elsewhere, as part of the superficial geology that includes both man-made and natural deposits. Further information on artificial ground can be found in the BGS Rock Classification Scheme Volume 4 available at: http://www.bgs.ac.uk/bgsrcs/details.html. More recently, as greater emphasis has been placed on the anthropogenic effects on the landscape, an enhanced classification of artificial ground was developed (Ford et al., 2010) and is currently being revised (Ford et al. in preparation). However, this enhanced scheme has not been implemented yet in BGS and the improved classifications do not appear in DiGMapGB data.

The current Artificial theme includes:

- Made Ground: man-made deposits such as spoil heaps and embankments on the natural ground surface; artificial raised ground
- Worked Ground: areas where the ground has been cut away such as stone quarries and gravel pits; road and railway cuttings
- Infilled Ground: areas where the ground has been cut away then wholly or partially backfilled such as reinstated quarries and opencast mineral sites
- Landscaped Ground: areas where the surface has been reshaped
- Disturbed Ground: areas of ill-defined shallow or near surface mineral workings where it is impracticable to map Made and Worked ground separately
- Reclaimed Ground: areas such as salt marshes and tidal flats that have been enclosed by an embankment and drained

Artificially Modified Ground was not systematically mapped by BGS until about the 1980s when it became a common requirement of the applied geological mapping projects, and is now routinely recorded. It is classified primarily on its mode of origin, which is usually apparent from the landform or the changes made to the topography.

Schemes exist for classifying Made Ground and Infilled Ground by their composition but these are not widely used in DiGMapGB data. Fill may comprise different types of material such as inert waste, ash or slag but it is not usually practicable in routine mapping to distinguish them as many landfills are mixed deposits with inadequate records of their actual content.

Caution must be exercised using the Artificial theme. Coverage and identification of artificial ground varies greatly depending on the date of survey, the surveyor and its physical expression in the landscape. Information is only available for parts of the country and it becomes dated very rapidly. BGS cannot monitor every pit and landfill site in the country, recording changes from day to day, and it is inevitable that many maps of artificially modified ground will be out-of-date. Consequently some large areas of artificial ground may not appear in the data. Also, many urban areas are built on artificial ground but it is impracticable to unravel the details in routine mapping.

1.3.2 Mass Movement theme

Mass movement deposits on BGS geological maps materials that have moved down slope under gravity to form landslides. These affect bedrock, other superficial deposits and artificially modified ground. Various types of landslide are recognised in classification schemes but they are rarely distinguished on series BGS maps, apart from specialised ones for applied geology, and they are not classified in DiGMapGB data..

For DiGMapGB and related purposes, landslide information is usually placed in the Mass Movement theme. Here it also includes foundered strata, where the ground has collapsed due to subsidence.

Further information on mass movement deposits can be found in the BGS Rock Classification Scheme Volume 4 available at: http://www.bgs.ac.uk/bgsrcs/details.html. In the Rock Classification Scheme, though, foundered ground is excluded from the mass movement deposits.

Caution must be exercised using the Mass Movement theme because of the potential hazard caused by ground instability. BGS has not always mapped mass movement deposits and they may occur in places where none are mapped. Even on maps where landslides are shown it is impossible to be sure that all occurrences were identified and recorded. It is therefore useful to know the location of potential landslip areas such as determined in some applied geological mapping projects.

In addition to the mapped landslides, BGS has used GIS techniques integrating geological and topographical information, to create a Natural Hazards (GeoSure) dataset which gives an indication of hazard rating for slope failure by finding, for example, the incidence of clays on steep slopes. This national dataset covers all of Great Britain. Further information is available at: http://www.bgs.ac.uk/products/geosure/home.html

1.3.3 Superficial theme

Superficial deposits (formerly termed 'drift' by BGS) are the youngest natural geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 2.6 million years from the present. They rest on older deposits or rocks referred to as bedrock.

For DiGMapGB and related purposes, most superficial deposits of natural origin are held in the Superficial theme. Other superficial deposits are held in the Mass Movement theme if they have been moved en masse or in the Artificial theme if they are man-made. Further information on superficial deposits can be found in the BGS Rock Classification Scheme Volume 4 available at: http://www.bgs.ac.uk/bgsrcs/details.html.

Most of these superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads. Almost all were formerly classified on the basis of their mode of origin with names such as, 'Glacial Deposits', 'River Terrace Deposits' or 'Blown Sand'; or on their composition such as 'Peat'. Recently some of them have been given formal lithostratigraphical names such as 'Lowestoft Formation'. More information on named superficial deposits is available in the BGS Lexicon of Named Rock Units at: http://www.bgs.ac.uk/lexicon/home.cfm.

Superficial deposits were originally recorded onshore where they were laid down by various natural processes such as action by ice (glacial), water (fluvial) and wind (aeolian). Around the coast superficial deposits were commonly mapped above the high water mark and in places below this and out across the tidal flats More recently, deposits around the coast and offshore have been mapped and may be held in a separate Sea Bed Sediments theme (DigSBS250) or be included in the new MareMap 1:50 000 offshore map series in preparation.

1.3.4 Bedrock theme

Bedrock geology (formerly known as 'solid' geology by BGS) is a term used for the main mass of rocks forming the Earth, and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water. The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 2.6 million years ago.

For DiGMapGB and related purposes all these rocks are placed in the Bedrock theme. Wherever possible, they are referred to by their current name: for stratified units this will usually be lithostratigraphical; for igneous intrusions it may be a lithodemic one. More information on named bedrock units is available in the BGS Lexicon of Named Rock Units at:
http://www.bgs.ac.uk/lexicon/home.cfm.

Geological maps usually show all the bedrock strata onshore, apart from beneath extensive spreads of superficial deposits such as coastal plain alluvium, and perhaps beneath inland water bodies. For DiGMapGB-50 the bedrock has been extrapolated, where possible, beneath these areas, including out to the low water mark around the coast. On some recently published 1:50 000 scale geological maps, bedrock is also mapped offshore on the Continental Shelf; but coverage is scattered and this data is not included in DiGMapGB.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary. These are described in the BGS Rock Classification Scheme Volumes 1 to 3 available at: http://www.bgs.ac.uk/bgsrcs/home.html

Igneous rocks are derived from molten magma in the Earth's crust. They may, for example, be extruded at the surface by volcanic activity, to form lavas and tuffs (ash); or intruded into other rocks to form large masses of granite and gabbro at depth, or minor crosscutting basalt dykes near the surface.

Metamorphic rocks such as schist and gneiss are those that have been changed from one rock type to another in the solid state by the recrystallisation of minerals, often at high temperatures and pressures when buried deep in the Earth's crust.

Sedimentary rocks are formed when grains and fragments of existing rocks are eroded away by ice, water and wind action, transported elsewhere and redeposited as sediment. These sediments are often laid down in layers or strata of loose particles of gravel, sand, silt and clay. Over time they may be buried by later sediments and consolidated or cemented to form stratified or bedded rocks such as conglomerate, sandstone, siltstone and claystone. Other sedimentary rocks such as ironstone and limestone are created by chemical or biogenic action.

The geological sequence of preserved rocks varies from place to place but packages of layered rocks or strata with similar characteristics may be recognisable over considerable distances. Such study has developed into the science of stratigraphy.

1.3.5 Availability of polygon (area) themes

The dataset of each onshore digital tile has up to four polygon themes (Artificial, Mass Movement, Superficial and Bedrock), although not all themes are shown on every tile. The availability of particular themes varies from tile to tile at the same scale and between tiles at different scales as can be seen via the links for 1:10 000 and 1:50 000 scale data at: http://www.bgs.ac.uk/products/digitalmaps/DiGMapGB_10.html and
http://www.bgs.ac.uk/products/digitalmaps/digmapgb_50.html#.

Most geological mapping in England and Wales records both bedrock and superficial deposits at the same time during a single survey. In Scotland, however, these two themes are often mapped by different surveys at different times for separate Bedrock and Superficial editions of the maps.

As a consequence, there may, for example, be a new Bedrock theme available for a particular digital tile but no Superficial theme; or only an old one.

Mass movement deposits are now routinely mapped but they were often not recorded on early geological maps.

Similarly, artificial ground has been recorded on large-scale maps since the 1960s, though the methodology has been progressively improved over the years with recent maps distinguishing more categories: made, worked, infilled (or worked and made), landscaped, disturbed and reclaimed ground. It remains impossible to keep the Artificial theme up-to-date as the ground surface is under continual modification by man and BGS cannot monitor every change. A map that has been recently surveyed will have a more comprehensive representation of the artificial ground than an older one.

The themes available for each dataset are given in Table 3. Most of these datasets are attributed with LEX_RCS geological codes which provide the name of each rock unit or deposit (via its LEX or Lexicon code) and composition or lithology (via its RCS or Rock Classification Scheme code); for example GUN–MDST is Gunthorpe Member–Mudstone). The Lexicon Codes and related information can be accessed at: http://www.bgs.ac.uk/lexicon/home.cfm;
and the BGS Rock Classification Scheme at: http://www.bgs.ac.uk/bgsrcs/home.html.

The basic themed geological information outlined above may be used with various types of related earth-science information to derive other geology-based maps: for example, on mineral resources, applied geology, geohazards, engineering geology, hydrogeology, geochemistry or geophysics.

Table 3 Availability of themes in DiGMapGB datasets.

DATASET	ARTIFICIAL	MASS MOVEMENT	SUPERFICIAL	BEDROCK	LINEAR FEATURES
DiGMapGB-10	PA	PA	A	A	A
DiGMapGB-25	PA	PA	A	A	A
DiGMapGB-50	PA	PA	A	A	A
DiGMapGB-250	N	N	N	A	A
DiGMapGB-625	N	Included in Superficial	A	A + Dykes	A

A available; N not available; PA partially available

Point data, including structural measurements such as dips and cleavage, will be made available at 1:10 000 and 1:25 000 scales in the future.

1.4 GEOLOGICAL LINEAR FEATURES THEME

Linear features at the ground surface or at rockhead (the bedrock surface beneath superficial deposits) are geologically attributed. Their availability in the digital data depends on the detail shown on the printed map. They are organised into seven main categories:

- ROCK e.g. coal seam, gypsum or ironstone bed
- FOSSIL HORIZON e.g. marine band
- FAULT e.g. normal, thrust, reverse
- FOLD AXIS e.g. anticline, syncline
- MINERAL_VEIN e.g. mineral vein
- ALTERATION_AREA e.g. limit of dolomitisation

- LANDFORM e.g. buried channel margin, glacial drainage channel margin

Many of the linear features are attributed generically: for example, a ROCK line may be identified as a coal seam or gypsum bed; a marine band or mussel bed fossil horizon. However, these rock units can also be identified with LEX_RCS codes in the same way as polygons and carry the same associated information fields. Thus particular coal seams or marine bands may be identified with specific LEX codes such as:

YCL (Yard Coal, Leicestershire) see http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=YCL,
AGMB (Aegiranum Marine Band) see http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=AGMB.

Similarly other linear features such as faults and mineral veins may also be attributed with more specific information, for example the name of the fault or the composition of the mineral.

Printed paper maps may also show ‘concealed’ linear features such as faults or coal seams on the ‘sub-Triassic’ surface, i.e. the assumed outcrop, or more correctly the subcrop, of these features (probably identified in coal mines or boreholes) projected on the unconformity below Triassic strata. These underground features are not included in the DiGMapGB Linear theme.

2 Technical details and use

2.1 SOURCES OF INFORMATION

Each tile of DiGMapGB digital data is typically based on the latest geological map available at that scale, though some may be of pre-metric (1970) vintage. Digital tiles, however, are not identical to the original paper maps. Each tile shows the geological units essentially as published, though modifications may have been made to the lines to create the separate themes in full where previously unmapped. Some tiles have required significant additional geological interpretation, for example: bedrock geology boundaries added beneath superficial deposits; artificial ground added within a quarry; superficial deposits added beneath artificial ground. Major revisions to the polygons or lines were generally avoided. Open areas were closed to form polygons and given geological attributes. These ‘hidden lines’ do not appear on the printed map and do not represent real geological lines; rather they show the minimum extent of the areas.

Regardless of the source or vintage of each map, the geological nomenclature was reviewed and revised, as far as reasonably practicable, to conform to the most up-to-date accepted usage. For a recent map, these changes, if any, are minimal. On an old map in contrast, some, or possibly many, of the deposits or rock units may be renamed. An attribute field in the data lists possible previous names of the unit as listed in the Lexicon. More specifically, a LEX_RCS, or earlier LEX_ROCK, BGS Quality Assurance form shows how the revised terminology relates to that on the existing published map. The sources of information are available from digital data if required.

2.2 DATA STRUCTURE

The data are routinely released in ESRI® SHP file format. Other GIS formats such as MapInfo® TAB are available on request. The digital tiles are geologically attributed to the latest version of the BGS Digital Map Production System. This is an integrated system of geological attribution and map production which standardises the methodology of digital mapping and data structure, providing the framework for the DiGMapGB project.

The standard data supplied to customers has polygons (or areas) of the four ‘geological’ themes (Artificial, Mass Movement, Superficial and Bedrock). The ‘geological’ lines, identified by type, are held in a Linear theme; some linear features are attributed with specific LEX_RCS codes.

A two-part attribute, referred to as a 'LEX_RCS' code, such as 'GUN–MDST', identifies every polygon in each theme by the name of the geological unit(s) or deposit(s) represented and their composition. The first part is the Lexicon code abbreviation for the name of the individual unit or the package of units where the components cannot be differentiated. Here GUN is the LEX code for the 'GUNTHORPE MEMBER'.

Geological units are defined in the BGS Lexicon of Named Rock Units which is available via the BGS website at: http://www.bgs.ac.uk/lexicon/home.cfm. Individual Lexicon definitions may be accessed directly by adding the LEX code to the end of the standard query: ‘http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=’. For example, the definition for the Gunthorpe Member (GUN) is available at: http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=GUN.

This same query was created as a LEX_WEB field and added to every polygon and attributed rock line in the data at attribute level 20, identified with a LEX code, providing a direct hyperlink to the particular Lexicon definition. The attribute level identifies the types of additional information supplied in DiGMapGB datasets. As information fields are added, renamed or removed so the attribute level is changed and a new number used.

In stratified units the name is a lithostratigraphical one, usually comprising a geographical prefix, with or without a lithological qualifier, followed by a rank (bed, member, formation, group or supergroup) for example Sherwood Sandstone Group, Cheviot Volcanic Formation. In some cases traditional names are retained such as Cornbrash or Gault formations that do not follow the standard rules of nomenclature but are so well known that it would be perverse to abolish them.

Intrusive and highly metamorphosed units are usually non-tabular and do not generally occur in stratified sequences so their position with respect to neighbouring units does not necessarily reflect their order of formation. These rocks are given lithodemic names with a qualifier that indicates the type of rock body (dyke, sill, pluton, intrusion, complex, suite or supersuite) for example Skye Dyke Swarm, Great Whin Sill, Shap Pluton or Ennerdale Intrusion.

The second part of the LEX_RCS label, for example MDST, is the RCS code abbreviation for the lithology of the unit: 'MUDSTONE'. This is derived from the hierarchical BGS Rock Classification Scheme (RCS) which is available via the BGS website at: http://www.bgs.ac.uk/bgsrcs/home.html.

Individual RCS definitions may be accessed directly by adding the RCS code to the end of the standard query: 'http://www.bgs.ac.uk/bgsrcs/rcs_details.cfm?code='. The definition for mudstone (MDST), for example, is available at: http://www.bgs.ac.uk/bgsrcs/rcs_details.cfm?code=MDST.

This same query was created as an RCS_WEB field and added to every polygon and attributed rock line in the data at attribute level 20, identified with an RCS code, providing a direct hyperlink to the particular lithological definition.

The lithology represented by this coding is usually the single predominant lithology present, or two or three main lithologies. Other minor or trace lithologies, not referred to, may also be present.

The lithology may also be expressed by an obsolete ROCK code, taken from an earlier BGS scheme and initially retained in DiGMapGB data in the LEX_ROCK field situated towards the end of the attribute table before being removed at attribute level 22.

2.3 POLYGON INFORMATION FIELDS

The information fields attached to DiGMapGB polygons are explained in Table 4.

Table 4 Information fields attached to polygons in DiGMapGB data.

Attribute level: 22 (see note1)	introduced in 2013 for DiGMapGB-50 Version 7 data	
DATA FIELD	**EXPLANATION OF DATA FIELD**	***COMMENT***
LEX_WEB	Direct hyperlink to the definition of the particular geological unit in the BGS Lexicon of Named Rock Units accessible via the BGS website: e.g. http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=GOG	*Note 19*
RCS_WEB	Direct hyperlink to the description of the lithology in the BGS Rock Classification Scheme accessible via the BGS website: e.g. http://www.bgs.ac.uk/bgsrcs/rcs_details.cfm?code=LMST	*Note 20*
LEX	A single Lexicon (or LEX) code of up to 5 characters (mostly letters) forming the first part of the primary LEX_RCS attribute. An abbreviation of the name used to identify the rock unit(s) or deposit(s) as listed in the BGS Lexicon of Named Rock Units: e.g. GOG	*Note 2*
LEX_D	Description of the Lexicon code above giving the full name of the unit(s): e.g. GREAT OOLITE GROUP is the name of the unit coded as GOG	
LEX_RCS	The primary two-part, LEX & RCS, code used to label the geological units in DiGMapGB data: e.g. GOG-LMST	*Notes 3 and 17*

RCS	A single rock-classification code of up to 6 characters (mostly letters) forming the second part of the primary LEX_RCS attribute. A single RCS code or a single abbreviation of two or more RCS lithologies as listed in RCS_X: e.g. MDCO	*Note 4*
RCS_X	One or more RCS codes listed individually. Multiple codes are joined by + signs with square brackets used for subordinate types: e.g. MDST + [CONG]	*Note 5*
RCS_D	Description of the RCS code(s) above giving the lithology of the unit: e.g. MUDSTONE AND [SUBEQUAL/SUBORDINATE] CONGLOMERATE is the description of the rock coded as MDST + [CONG]	
RANK	Rank of the unit in the lithostratigraphical or lithodemic hierarchy: e.g. GROUP or SUITE	
BED_EQ	Bed equivalent. Lexicon code for the unit at bed or equivalent level where applicable	*Note 6*
BED_EQ_D	Description of BED_EQ above; name of unit at bed level	
MB_EQ	Member equivalent. Lexicon code for the unit at member or equivalent level where applicable	
MB_EQ_D	Description of MB_EQ above; name at member level	
FM_EQ	Formation equivalent. Lexicon code for the unit at formation or equivalent level where applicable	
FM_EQ_D	Description of FM_EQ above; name at formation level	
SUBGP_EQ	Subgroup equivalent. Lexicon code for the unit at subgroup or equivalent level where applicable	
SUBGP_EQ_D	Description of SUBGP_EQ above; name at subgroup level	
GP_EQ	Group equivalent. Lexicon code for the unit at group or equivalent level where applicable	
GP_EQ_D	Description of GP_EQ above; name at group level	
SUPGP_EQ	Supergroup equivalent. Lexicon code for the unit at supergroup or equivalent level where applicable	
SUPGP_EQ_D	Description of SUPGP_EQ above; name at supergroup level	
MAX_TIME_Y	Maximum age, in years, of the oldest time division during which the geological unit was formed: e.g. 335000000	*Note 7*
MIN_TIME_Y	Minimum age, in years, of the youngest time division during which the geological unit was formed: e.g. 316000000	
MAX_INDEX	Maximum index. A number representing the maximum age (earliest or oldest time) of the unit: MAX_TIME_D field. Used for GIS querying and legend building: e.g. 13222120	*Note 8*
MIN_INDEX	Minimum index. A number representing the minimum age (latest or youngest time) of the unit: MIN_TIME_D field. Used for GIS querying and legend building: e.g. 13213140	
MAX_AGE	Maximum age. Name of the age of maximum geochronological time applicable: e.g. ASBIAN	*Same if unit spans only one Age.* *Note 9*
MIN_AGE	Minimum age. Name of the age of minimum geochronological time applicable: e.g. ALPORTIAN	
MAX_EPOCH	Maximum epoch. Name of the epoch of maximum geochronological time applicable: e.g. VISEAN	*Same if unit spans only one Epoch*
MIN_EPOCH	Minimum epoch. Name of the epoch of minimum geochronological time applicable: e.g. NAMURIAN	
MAX_SUBPER	Maximum sub-period. Name of the sub-period of maximum geochronological time applicable: e.g. MISSISSIPPIAN	*Same if unit spans only one Sub-period*
MIN_SUBPER	Minimum sub-period. Name of the sub-period of minimum geochronological time applicable: e.g. PENNSYLVANIAN	
MAX_PERIOD	Maximum period. Name of the period of maximum geochronological time applicable: e.g. CARBONIFEROUS	*Same if unit spans only one*

MIN_PERIOD	Minimum period. Name of the period of minimum geochronological time applicable: e.g. PERMIAN	*Period*
MAX_ERA	Maximum era. Name of the era of maximum geochronological time applicable: e.g. PALAEOZOIC	*Same if unit spans only one Era*
MIN_ERA	Minimum era. Name of the era of minimum geochronological time applicable: e.g. MESOZOIC	
MAX_EON	Maximum eon. Name of the eon of maximum geochronological time applicable: e.g. PROTEROZOIC	*Same if unit spans only one Eon*
MIN_EON	Minimum eon. Name of the eon of minimum geochronological time applicable: e.g. PHANEROZOIC	
PREV_NAME	Previous name(s) for the unit as listed in the BGS Lexicon of Named Rock Units	*Note 10*
BGSTYPE	The DiGMapGB theme: e.g. BEDROCK, SUPERFICIAL, MASS MOVEMENT or ARTIFICIAL	*Note 11*
LEX_RCS_I	Concatenation of Lexicon and RCS codes, prefixed by the maximum index number: e.g. 12303999_MMG_MDGYAN	*Note 12*
LEX_RCS_D	Description of LEX_RCS above: e.g. MERCIA MUDSTONE GROUP - MUDSTONE WITH GYPSUM-STONE AND/OR ANHYDRITE-STONE	
BGSREF	BGS reference colour for the polygon based on the LEX_RCS code pair. The default printing colour defined as a 3-digit number: e.g. 626 (for Radcliffe Member–mudstone and sandstone). Used for legend building to give a similar appearance to the published map	
BGSREF_LEX	Alternative BGS reference colour at the Lexicon code level, LEX, as defined above: e.g. 626 (where no alternative needed as no clashes same colour used as above)	
BGSREF_FM	Alternative BGS reference colour at the formation level, FM_EQ, as defined above: e.g. 266 for Sidmouth Mudstone Formation which includes Radcliffe Member	
BGSREF_GP	Alternative BGS reference colour at the group level, GP_EQ, as defined above: e.g. 505 for Mercia Mudstone Group which includes Sidmouth Mudstone Formation	
BGSREF_RK	Alternative BGS reference colour for the lithology RCS code, as defined above: e.g. 365 for mudstone and sandstone lithology of Radcliffe Member	
SHEET	Digital geological tile (number and name based on published map sheet) that the polygon appears on: e.g. ew075_preston; sc084e_nairn where prefix 'ew' is for England & Wales and 'sc' for Scotland	
VERSION	Version number and attribute level of the digital data: e.g. 7.22 is version 7, with attribute level 22. The version number is changed when a new dataset is released following major changes or periodic update	*Notes 1 & 13*
RELEASED	Date the DiGMapGB data files were created by BGS: e.g. 15-04-2013	
NOM_SCALE	Nominal scale of the published (or compiled) information used to prepare the digital data: e.g. 50000 for 1:50 000 [including 1:63 360 and 1:100 000 maps]. Also gives an indication of scale-dependant accuracy	*Note 14*
NOM_OS_YR	The latest year date of topographical information contained in the base map used for the original printed geological map (or the base used for DiGMapGB compilations). Where not known, field is null	*Note 15*
NOM_BGS_YR	The latest year date of the principal BGS geological information contained in the digital tile. This is usually the year of publication of the most up-to-date map sheet. Where no published map was available it is the year of compilation for DiGMapGB. Where not known or inappropriate, field is null	*Note 16*
UUID	Universally Unique Identification that can be used to identify individual features: e.g. bgsn_digmap1004081046355357_50k	*Note 18*

ADDITIONAL EXPLANATORY NOTES	
Note 1	*The attribute level identifies the types of additional information supplied in DiGMapGB datasets. As information fields are added, renamed or removed so the attribute level is changed and a new number used*

Note 2	*The Lexicon is a BGS database of named rock units and definitions that can be viewed on the Internet at: http://www.bgs.ac.uk/lexicon/home.cfm. The Lexicon name may refer to a single identifiable unit or a package of units where the individual components cannot be differentiated. The majority of stratified rock units are given a lithostratigraphical name whilst non-stratified units, such as igneous intrusions and some metamorphic bodies, have a lithodemic name. As these are mutually exclusive DiGMapGB uses the same information-field names for both types*
Note 3	*The primary geological attribution is the LEX_RCS pair, which is then used to link to other BGS databases and thereby provide the information used to populate the other information fields*
Note 4	*The RCS codes are based on the hierarchical BGS Rock Classification Scheme (RCS) which is available in 4 Volumes that can be downloaded free at: http://www.bgs.ac.uk/bgsrcs/home.html. RCS was adopted as the field name at attribute level 16 for the single or abbreviated lithology code. The field may include abbreviated codes for multiple lithologies*
Note 5	*The RCS_X field provides a searchable list of individual RCS lithology codes. This field is the same as the RCS field in DiGMapGB data at attribute levels 10 to 14. The suffix _X was added to distinguish this listing of the components from the single or abbreviated code now shown in the RCS field. Codes are listed alphabetically; major ones first, followed by [subordinate] ones*
Note 6	*The parentage of each rock unit is provided, in so far as it is available. Thus a named unit of bed rank may be part of a named member, which is itself part of a formation. Several formations may make up a group and several groups may form a supergroup. A formation is the prime mapping-unit and need not be divided up into named members or beds; nor does a formation have to belong to a group or supergroup. 'NotAp' is the abbreviation for 'Not Applicable' and is used to indicate that it is not appropriate to list child units of lower rank; NoPar is the abbreviation for No Parent and is used to indicate that no parental unit of higher rank has been identified*
Note 7	*These are ages, in years as shown on the BGS Geological Timechart available at: http://www.bgs.ac.uk/downloads/browse.cfm?sec=8&cat=39 where they are expressed as 'million years'. Some of these values are interpolations; the +/- error ranges are not provided here. The age range given is that for the time period ascribed to each geological unit in the BGS Lexicon. They do not give absolute age measurements made on the individual geological units. MAX_TIME_D and MIN_TIME_D fields, giving the names of the maximum and minimum time divisions applicable to the unit, were dropped for attribute level 22*
Note 8	*The index number is a hierarchical 8-digit number, based on the geochronological age of the geological unit as defined in the Lexicon. It allows rock units to be selected or queried by their age. The number ranges from 10000000 (the youngest) up to 39999999 (the oldest) with 0 used for units where the age is Not Available, and 99999999 where an age is Not Applicable.*
Note 9	*Sub-divisions of age called chrons are also shown in this field as a hyphenated name, for example Streffordian-Actonian is used for the Actonian Chron which is the early part of the Streffordian Age. New fields for maximum and minimum chrons have not been created as they are only used in the Caradoc at present*
Note 10	*Possible previous name(s) for the unit are given as listed in the BGS Lexicon of Named Rock Units. These names may have been used for all or part of particular polygons in particular areas as shown in DiGMapGB data e.g. Keuper Marl and Keuper Series are two of the possible previous names used for the Mercia Mudstone Group. Individual names are separated by a double space. The field length is limited and long lists are truncated to 250 characters due to the shapefile format*
Note 11	*There are four types of mapped unit in DiGMapGB: BEDROCK (formerly solid geology), SUPERFICIAL (formerly drift deposits), MASS MOVEMENT (mainly landslides) and ARTIFICIAL (artificially modified ground) which are held as separate layers of geological data for use in GIS*
Note 12	*This concatenated field is used for generating legends automatically for maps or reports as it places units in approximately the correct stratigraphical order, with youngest at the top and oldest at the base. Units that have the same age have the same index number and will be ordered alphabetically*
Note 13	*Different datasets with the same attribute level have the same structure so programming code used to query one dataset will operate on another at the same level. Users are advised to check the functionality of their GIS applications when the attribute level is changed*
Note 14	*The different DiGMapGB scales are 10000 for 1:10 000 [including 1:10 560]; 25000 for 1:25 000; 50000 for 1:50 000 [including 1:63 360 and 1:100 000 maps]; 250000 for 1:250 000 and 625000 for 1:625 000. Digital data should normally only be used at scales similar to the source data; for example 1:50 000 data are not suitable for use at 1:10 000 scale without great caution. See guidance on use of geological map data.* *This number can also be used as an indication of the cartographic accuracy of geological maps in mm. Lines are generally regarded as cartographically accurate to within 1 mm on the printed map: so they should be accurate to: 10 m (10 000 mm) at 10k or 1:10 000 scale; 50 m (50 000 mm) at 50k or 1:50 000 scale; 250 m (250 000 mm) at 250k or 1:250 000 and 625 m (625 000 mm) at 625k or 1:625 000 , though this last is often rounded up to 1 km. This is not a measure of the accuracy of the geological surveying. These accuracy ranges may also be regarded as the sizes of the smallest deposits on the ground that can be shown on a map when depicted as 1 mm polygons (the smallest polygon that can take discernible colour infill)*
Note 15	*This is typically an Ordnance Survey topographical base map but other sources of base map may be used. Further details are available if required*
Note 16	*For attribute level 22 the age information for the topographic base (NOM_OS_YR) and the geological map (NOM_BGS_YR) were improved so that where the Bedrock and Superficial (plus Artificial and Mass Movement) themes come from different sources, the correct age for each is given. Fuller details are available if required*

Note 17	*LEX_ROCK code pairs were used in the preparation of DiGMapGB data up to 2007 before being replaced by the LEX_RCS code pairs that now carry the primary attribution and link to other BGS databases. The LEX_ROCK codes were retained up to attribute level 20, for compatibility with earlier data and applications written for them, before being dropped from the data at level 22*
Note 18	*The Universal Unique Identifier (UUID) was first introduced to DiGMapGB-50 data at V6.20 in 2010. UUIDs are used for auditing, tracking changes to the data and for reporting errors. The prefix bgsn_ globally indicates the data originated at BGS and is fully compliant with the Digital National Framework (DNF) standards. Its inclusion coincided with the removal of the MSLINK number from the data.*
Note 19	*The LEX_WEB link was first added to DiGMapGB-50 data at V6.20 in 2010. It is created by appending the LEX code to the standard query: 'http://www.bgs.ac.uk/Lexicon?lexicon.cfm?pub='.*
Note 20	*The RCS_WEB link was first added to the DiGMapGB-50 data at V6.20 in 2010. It is created by appending the RCS code to the standard query: 'http://www.bgs.ac.uk/bgsrcs/rcs_details.cfm?code=' Information is only directly available for single lithologies; information for composites can be accessed by appending the individual RCS code (as listed in RCS_X) to the query*

2.4 LINEAR INFORMATION FIELDS

Thin geological units such as coal seams and marine bands, all of which are shown as lines on maps, are attributed with LEX_RCS coding and carry the same related fields as polygons. The various linear geological features are grouped into seven categories (Table 5A) which are published as one Linear theme.

Three fields identify the category and the specific geological feature attributed to each line (Table 5B).

When used separately, each linear feature in the digital data is attributed with a range of information fields that apply to the particular category, thus ROCK units such as coal seams have different information fields to FAULT lines.

Specific fields are included on particular types of feature such as faults and mineral veins (Table 5C) but not all fields are populated as they may be for use at different scales.

Table 5 Information fields attached to lines in DiGMapGB data.

5A

CATEGORY	FEATURE
ROCK	Coal, gypsum, sandstone, limestone nodule, cementstone, ironstone, manganese, tonstein, oil shale and pebble beds; inferred or observed
FOSSIL_HORIZON	Algal, brachiopod, coral, Euestheria, Lingula, goniatite, marine, mussel, Planolites bands, bone or fish beds: inferred or observed
FAULT	Undifferentiated, Normal, thrust, reverse, slide, oblique slip, strike slip, shear zone, scissor; inferred or observed; incrop of fault
MINERAL_VEIN	Inferred or observed
FOLD_AXIS	Anticline, syncline, anticline/syncline pair; antiform, synform, antiform/synform pair; monocline; reclined; recumbent; chevron; concentric; disharmonic; kink; pre-lithification, ptygmatic; similar; unknown
ALTERATION_AREA	Limit of dolomitisation, reddening, hydrothermal alteration, metamorphic aureole, migmatisation, granite vein, granite pegmatite vein, pegmatite, diorite-granodiorite. Alteration areas are within the limiting line
LANDFORM	Backfeature of former coast / lake margin / river terrace; buried channel centre / margin; drift-filled hollow; drumlin crestline / line at base; dune crestline / line at base; elongate margin crestline; esker crestline / line at base; glacial drainage channel centre / margin; linear feature crestline; marked break in slope; top of landslide back scar ; lower (toe) / side limit of landslide deposit where concealed beneath superficial deposits; open tension cracks from mass movement

5B

DATA FIELD	EXPLANATION OF LINEAR FIELD
CATEGORY	Geological unit category e.g. ROCK used for geological units that form thin beds too narrow to be shown as polygons carrying a colour on the traditional printed map face
FEATURE	Geological feature, in abbreviated form, e.g. Coal_seam_Obs; Ironstone_bed_Inf
FEATURE_D	Description of FEATURE above in full e.g. Coal seam, observed; Ironstone bed, inferred; Fossil horizon, Marine band

5C

EXAMPLE FEATURE	EXPLANATION OF FEATURE
FLTNAME_C	Fault name. A code abbreviation, up to 4 characters, giving the name of the fault: e.g. HIBO
FLTNAME_D	Description of the FLTNAME code above giving the name of the fault: e.g. Highland Boundary Fault is the full name of the linear feature coded as HIBO
MINERAL_C	Mineral type. A code abbreviation, up to 4 characters, giving the first mineral listed on the linear feature: e.g. ANDA
MINERAL_D	Description of the Mineral code above giving the name of the mineral in full: e.g. ANDALUSITE is the full name of the mineral coded as ANDA

2.5 GUIDANCE ON USE OF GEOLOGICAL MAP DATA

Geological observations are made according to the prevailing understanding of the subject at the time. The quality of such observations may be affected by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.

Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subject to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.

Detail clearly defined and accurately depicted on large-scale maps of small areas may be removed or exaggerated when small-scale maps of large areas are derived from them by generalisation.

Data may be compiled from the disparate sources of information at the BGS's disposal, including material donated to the BGS by third parties. Whilst such data may not have been subject to any verification or other quality control process it will have been considered by a geologist prior to inclusion in, or the influencing of, a geological map.

Data, information and related records that have been donated to the BGS have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for its intended use.

The data, information and related records supplied by the BGS should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.

If a report or other output is produced for you on the basis of data you have provided to the BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.

Digital data should be used that are fit for purpose and at an appropriate scale, normally at about the same scale as their original compilation. This scale is embedded in the DiGMapGB data attached to every feature as a ‘nominal scale’ value (NOM_SCALE). The 1:250 000 scale data should not, for example, be enlarged and used at 1:50 000; 1:50 000 scale data should not be used at 1:10 000 scale, nor 1:10 000 scale data used at 1:1250 scale.

Geological maps were originally fitted to a particular topographical base (mostly Ordnance Survey). An indication of the age of each base is given by a 'nominal topographic year' value (NOM_OS_YR), which provides the date of the latest revision made to the base. Care must be taken with interpretations linked to topography, particularly when the geological data are displayed on to a topographic base of different age to that specified by the year embedded in the DiGMapGB data. The geology may not fit a more recent topography, for example.

Different scales are suitable for a range of different uses. For example 1:10 000 scale data can be used for site development (but should not be relied on for site-specific information); 1:50 000 for local planning; 1:250 000 for regional planning; and 1:625 000 for national overviews or strategic planning.

If users are uncertain about the use of particular data they should seek professional advice. They may consult the BGS contacts listed at the end of this document on technical matters, licensing arrangements, or geological aspects including the appropriateness and limitations of the data.

3 Geological background information

3.1 GEOLOGICAL MAP-MAKING AND GENERALISATION

Most onshore geological surveying was carried out on large-scale maps at 1:10 000 scale (formerly 1:10 560, six-inch to one-mile) and for much of the country this is the most detailed geological mapping available. This primary-source geological map is an interpretation based on the geologist's 'field' observations and other available information. It involves initial selection at the time of survey or revision; deciding what is significant and in need of depiction, and what is trivial and therefore need not be mapped. As much of the bedrock geology is concealed by superficial deposits, soil, vegetation or water, its features are often interpolated from borehole records or surface exposures elsewhere, rather than determined by direct observation. Further, in order to show the geology on the map, some simplification or generalisation may be required, for example several small ill-defined patches of peat may be depicted as a single deposit. For a more detailed discussion of generalisation and other 'accuracy' issues see Smith, 2009a.

This geology was then usually published at later dates in less-detailed form on smaller-scale maps at 1:50 000, 1:250 000 or 1:625 000 scales by a process of successive generalisation. These modifications were determined in part by cartographical considerations; for example a small polygon representing an important igneous intrusion may be exaggerated in size on the 1:50 000 scale map in order to retain it at this smaller scale and allow some colour infill, whereas a small less important deposit of head, for example, might be omitted.

Geological units with a lithostratigraphical nomenclature are given a rank in a hierarchy that ranges from 'Bed' (the smallest), to 'Member', 'Formation', 'Group' and 'Supergroup' (the largest). Thus, a particular rock unit may be mapped originally as a thin bed at 1:10 000 scale. When published at 1:50 000 it may not be possible to show this bed but if it forms one component of a thicker member then that may be shown instead. Similarly, on subsequent compilation at 1:250 000 and 1:625 000 the detail may have to be further simplified, referring to larger units at formation level then group or supergroup level respectively.

Considering the Artificial and Mass Movement themes, these deposits are recorded at 1:10 000 scale and may be published at 1:50 000 scale with the usual cartographical selection and simplification of small areas; and perhaps exaggeration in size if particularly important; or deleted if not. These themes are not normally shown on 1:250 000 and 1:625 000 scale maps.

The 1:250 000 scale DiGMapGB data reflect the date of compilation of the paper source maps, 1977–92 and onwards. In the intervening years many of the component 1:50 000 maps were re-surveyed or revised but most of this new information has not been incorporated into the small-scale 1:250 000 maps. Similarly there may be detailed 1:10 000 scale maps available for some areas where the most recent geology has not yet been published on 1:50 000 scale maps.

3.2 COLOUR ON GEOLOGICAL MAPS

DiGMapGB seeks to replicate the printed colours as far as possible, though in some cases new default colours have been established for the purpose of rationalisation countrywide. In addition there are colours for rock units at formation and group level, and for the lithology. DiGMapGB data thus provides up to five different colours for each geological unit, as shown in Table 6, which should be regarded only as recommendations that were valid at the time the dataset was created.

Table 6 Colours provided in DiGMapGB data.

COLOUR	EXPLANATION
BGSREF	Colour for use when symbolising according to the name and lithology of the unit (LEX_RCS). This is the BGS reference colour that replicates the printing colour as far as possible, though in some cases new default colours have been established for the purpose of rationalisation countrywide
BGSREF_LEX	Colour for use when symbolising according to the name of unit (LEX)
BGSREF_FM	Colour for use when symbolising according to the name of unit at formation level (FM_EQ)
BGSREF_GP	Colour for use when symbolising according to the name of unit at group level (GP_EQ)
BGSREF_RK	Colour for use when symbolising according to the lithology of unit (RCS)

Colours specified are subject to change and users are able to change the colours of the geological units on screen or on plots according to their own requirements.

Each one of the information fields on colour typically has a three-digit YCM (Yellow, Cyan and Magenta) number, for example 912. Leading zeros are lost so 003 would be given as 3, and 040 as 40. Each digit can be separately interpreted using the percentages given in Table 7.

Table 7 Specifying colour percentages in DiGMapGB data.

Digit	0	1	2	3	4	5	6	7	8	9
%	0	7	14	21	31	42	54	67	80	100

For example if the BGSREF is 912, the relative proportions of the three YCM colour components are: Yellow, 100% (9) + Cyan, 7% (1) + Magenta, 14% (2).

These YCM colours can also be converted to RGB (red, green and blue) colours using the following formulae:

Red = 255 – (cyan% x 2.55)
Green = 255 – (magenta% x 2.55)
Blue = 255 – (yellow% x 2.55)
Thus 912 YCM = red 237, green 219, blue 0

This information can be used to build legends and keys. BGS uses these formulae to build legends supplied with the data in ESRI® ArcGIS, ESRI® ArcView, and MapInfo®. They can be used by licensees to give the same functionality within their own systems and BGS can help provide the necessary code on request.

3.3 GEOLOGICAL TIME AND CHRONOSTRATIGRAPHY

There are a number of ways of describing geological time. Most are ‘relative’ in which the Earth’s geology is subdivided into named units based on their stratigraphical relationships or relative ages, with younger strata typically overlying older strata in undeformed sedimentary sequences. Some ways, in contrast, are ‘absolute’ and typically measure time units in millions of years.

Chronostratigraphy, or time stratigraphy, deals with ‘time-rock’ units and refers to the sequence of rocks deposited in a particular time span. There is an established formal hierarchy of chronostratigraphical terms, shown in Table 8, in which the principal ranks range from eonothem (large) to stage (small).

Table 8 Chronostratigraphical and geochronological hierarchies.

Chronostratigraphical [time-rock] Divisions	Eonothem	Erathem	System	Series	Stage
Geochronological [time] Divisions	Eon	Era	Period	Epoch	Age
Example	*Phanerozoic*	*Palaeozoic*	*Silurian*	*Wenlock*	*Gorstian*

Geochronology, as used here, deals with 'time' units and refers to the time spans themselves. The corresponding principal formal geochronological terms range from eon to age. The same name can be used in both schemes; thus rocks of the Jurassic system were deposited during the Jurassic period of time; rocks of the Bathonian stage during the Bathonian age times.

In 2004, BGS adopted a Geochronology Index to refer to geological time, replacing its Chronostratigraphy index. The opportunity was taken to update the BGS timechart (http://www.bgs.ac.uk/discoveringGeology/time/timechart/home.html) and remove a few anomalies, for example the Llandeilo Epoch was replaced by the Llandeilian Age (the later part of a newly extended Llanvirn Epoch).

In 2010, the BGS corporate dictionary or database for geochronology was replaced by an updated version. As a result, for example, two terms (Silesian and Dinantian) were made obsolete.

The Geochronology Index also shows the absolute age in million years for the start and end of each time unit, for example, the Carboniferous Period lasted from about 359 to 299 million years ago according to the time chart produced by the International Commission on Stratigraphy. Some values are interpolations between 'known' ages rather than direct measurements. They may have a recognised +/- potential error range, and will be subject to further revisions as age-dating techniques are refined and geological understanding improved.

The latest version of the ICS time chart is available online at:
http://www.stratigraphy.org/index.php/ics-chart-timescale

3.4 GEOLOGICAL DESCRIPTION

3.4.1 Lithology

Rocks may be described in a number of different ways. Their lithology, for example, may be loosely defined in terms of their general characteristics or appearance: their colour, texture and composition, as seen in hand specimens and outcrops rather than with a microscope or chemical analysis.

The BGS Rock Classification Scheme (RCS), which is available in four volumes for download at: http://www.bgs.ac.uk/bgsrcs/home.html, provides hierarchies that can be used to describe rocks to varying levels depending on the information available.

The igneous rocks are described in Volume 1 (Gillespie and Styles, 1999) which has now been revised (Gillespie and Styles, in preparation). Similarly Volume 2, describing the metamorphic rocks (Robertson, 1999), has also been revised (Styles, Bauer and Robertson, in preparation). Sediments and sedimentary rocks are described in Volume 3 (Hallsworth and Knox, 1999). These three volumes provide schemes for classifying such rocks with single lithologies as seen in hand specimens and form the basis for the RCS codes used in the Bedrock theme in DiGMapGB data.

Volume 4 (McMillan and Powell, 1999) in contrast, classifies both man-made and natural superficial deposits (including landslides) according to their genesis and overall form or gross composition and this forms the basis for their names in the BGS Lexicon and hence their LEX codes as used in three DiGMapGB themes: Artificial, Mass Movement and Superficial; not their RCS codes.

For the purpose of making digital maps each rock unit is labelled with a lithological code based upon the Rock Classification Scheme, for example MDST is the code for 'MUDSTONE'. Many rock units, though, comprise more than one lithology; for example, a formation of interbedded mudstone and limestone may be attributed with the composite code MDLM. Here the individual components in the mixed lithology are listed separately in the RCS_X field.

For the superficial deposits an unlithified deposits coding scheme (UDCS) was developed by Cooper et al. (2006). This provides RCS codes for unlithified sediments based on the presence of the six granular end members (clay, **C**; silt, **Z**; sand, **S**; gravel, **V**; cobbles, **L**; boulders, **B**) and peat, **P**. The UDCS codes were then extended by the use of an ‘X’ prefix in order to include composites. For example, whereas VSL describes an admixed lithology of Cobbly Sandy Gravel, an interbedded sequence of Gravel, Sand and Cobbles is coded as XVSL.

3.4.2 Lithostratigraphical terminology

Rocks are often deposited in layers or strata, and the sequence of these strata can be correlated from place to place. These sequences of different rocks are used to establish the changing geological conditions or geological history of the area through time. The description, definition and naming of these layered or stratified rock sequences is termed lithostratigraphy (rock stratigraphy). The strata can also be described in other ways depending on the types of information available: for example in biostratigraphy (life stratigraphy) fossils are used.

Lithostratigraphy is fundamental to most geological studies. Rock units are described using their gross compositional or lithological characteristics and named according to their perceived rank in a formal hierarchy. The main lithostratigraphic ranks in this hierarchy are: Supergroup, Group, Subgroup, Formation, Member and Bed. The units are usually named after a geographical locality, typically the place where exposures were first described.

Table 9 Lithostratigraphical hierarchies.

<table>
<tr><th></th><th>Rank 1</th><th>Rank 2</th><th>Rank 3</th><th>Rank 4</th><th>Rank 5</th><th>Rank 6</th></tr>
<tr><td rowspan="13">Litho-stratigraphic units</td><td></td><td></td><td></td><td>Formation J</td><td></td><td></td></tr>
<tr><td rowspan="10">Supergroup B</td><td rowspan="6">Group C</td><td></td><td>Formation K</td><td></td><td></td></tr>
<tr><td rowspan="2">Subgroup F</td><td>Formation L</td><td></td><td></td></tr>
<tr><td>Formation M</td><td></td><td></td></tr>
<tr><td rowspan="3"></td><td rowspan="3">Formation N</td><td rowspan="2">Member U</td><td>Bed W</td></tr>
<tr><td>Bed X</td></tr>
<tr><td>Member V</td><td></td></tr>
<tr><td rowspan="4">Group D</td><td rowspan="2">Subgroup G</td><td>Formation O</td><td></td><td></td></tr>
<tr><td>Formation P</td><td></td><td></td></tr>
<tr><td rowspan="2">Subgroup H</td><td>Formation R</td><td></td><td></td></tr>
<tr><td>Formation S</td><td></td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Formation T</td><td rowspan="2"></td><td>Bed Z</td></tr>
<tr><td></td></tr>
<tr><td>DiGMapGB Fields</td><td>SUPGP_EQ</td><td>GP_EQ</td><td>SUBGP_EQ</td><td>FM_EQ</td><td>MB_EQ</td><td>BED_EQ</td></tr>
</table>

These formal ranks are often appended to names in the BGS Lexicon of Named Rock Units. Formations are the fundamental rock units for mapping purposes and can stand-alone; they do not have to belong to a group and need not be split into smaller units. A group is an assemblage of related and adjacent formations and may be subdivided into subgroups. A supergroup is an assemblage of groups. A member is a sub-division of a formation and a bed is the smallest formal unit. Some possible lithostratigraphic relationships are shown schematically in Table 9.

In this hierarchical scheme, each unit may have parent and child relationships with other units of greater and lesser rank respectively. Formation J does not belong to a group, nor is it subdivided. Part of Group C is recognised as Subgroup F comprising two formations, L and M. Formation N is divided into Members U and V; with Member U comprising beds W and X. Bed Z forms part of Formation T.

The names of the relevant DiGMapGB fields at each of these ranks are also shown.

3.4.3 Lithodemic terminology

Where rocks are not laid down in stratified sequences and cannot be accommodated in the lithostratigraphical scheme they are instead given names using a lithodemic scheme, as shown in Table 10. These can be applied to igneous intrusive, highly deformed and/or highly metamorphosed and genetically mixed assemblages of rocks.

Table 10 Lithodemic hierarchies.

<table>
<tr><th></th><th>Rank 1</th><th>Rank 2</th><th>Rank 3</th><th>Rank 4</th><th>Rank 5</th><th>Rank 6</th></tr>
<tr><td rowspan="2">intrusive units</td><td rowspan="2">supersuite</td><td rowspan="2">suite</td><td rowspan="2">subsuite</td><td rowspan="2">centre
cluster</td><td>pluton
ring-intrusion
lopolith
intrusion-swarm</td><td>intrusion</td></tr>
<tr><td>laccolith-swarm
plug-swarm
vent-swarm
pipe-swarm
neck-swarm
diatreme-swarm
sheet-swarm
dyke-swarm
sill-swarm
ring-swarm
cone-sheet-swarm
vein-swarm</td><td>laccolith
plug
vent
pipe
neck
diatreme
sheet
dyke
sill
ring-dyke
cone-sheet
vein</td></tr>
<tr><td rowspan="2">tectono-metamorphic units</td><td>super-assemblage</td><td>assemblage</td><td>sub-assemblage</td><td>set</td><td>train, swarm</td><td>lens, block</td></tr>
<tr><td>super-succession</td><td>succession</td><td>sub-succession</td><td>package</td><td>unit</td><td>layer, mass</td></tr>
<tr><td>mixed class units</td><td>super complex</td><td>complex</td><td>subcomplex
ophiolite-complex
central complex
volcano-complex</td><td>sheet-complex
sill-complex
vein-complex
ring-complex</td><td></td><td></td></tr>
<tr><td>DiGMapGB fields</td><td>SUPGP_EQ</td><td>GP_EQ</td><td>SUBGP_EQ</td><td>FM_EQ</td><td>MB_EQ</td><td>BED_EQ</td></tr>
</table>

In the lithodemic hierarchy applied to intrusive igneous rocks, developed for BGS (Gillespie, Stephenson and Millward, 2008; Gillespie, Campbell and Stephenson, 2011) units are placed into one of six ranks (Table 10); the same number as in the lithostratigraphic scheme, although there is not necessarily any direct equivalence in the rank.

In this hierarchical scheme each lithodemic unit may be part of a ‘parent’ unit of greater rank or may be composed of ‘child’ units of lesser rank. Thus within the intrusive units a pluton may be part of a suite or subsuite, and may itself comprise several intrusions.

A similar scheme (Table 10) has been developed for the metamorphic and tectono-metamorphic units (Leslie, Krabbendam and Gillespie, 2012). Here an assemblage may comprise several sets (if dispersed) or packages (if contiguous) and within these there may be lenses and blocks, for example. In addition to these, where there are mixtures of rocks such as igneous intrusive and sedimentary or igneous intrusive and metamorphic, then a hierarchy based on the ‘complex’ has been developed.

Rock units are described using their gross compositional or lithological characteristics and named according to their perceived rank in a formal hierarchy. These formal ranks are often appended to names in the BGS Lexicon of Named Rock Units. The name of the relevant DiGMapGB field at each rank is also shown. For expediency the lithodemic hierarchy uses the same field names as the lithostratigraphic hierarchy; the ‘EQ’ suffix for ‘Equivalent’ does not imply exact geological equivalence of rank between lithostratigraphic and lithodemic units, it is a convenience facilitating the supply of data in a unified and consistent way.

3.5 GEOLOGICAL STRUCTURES

3.5.1 Faults

Geological faults are the most common feature in the Linear theme of the DiGMapGB data but uncertainties often affect their mapped position at the surface or rockhead. A fault is a fracture or zone of fractures along which the materials on opposing sides of the fracture have been displaced, relative to one another, by movements parallel to the surface of the fault. Where one side of a fault is downthrown relative to the other, the downthrow side is indicated by a small ‘tick’ on the fault line. In the latest DiGMapGB data, faults with a specified downthrow side have a line-style that has downthrow ticks (automatically placed) for display purposes. However, these have not been systematically checked to ensure they are on the correct side. Most faults in the data do not have a specified downthrow side even though many of them have cosmetic ticks (cartographically placed) on the printed map. Information on fault throw remain partial therefore in both the 1:50 000 and 1:10 000 scale data.

A fault may split (‘splay’) and the separate surfaces effectively become a fault zone rather than a single fault; fault zones may be up to tens of metres wide. Movements along faults may crush the rocks adjacent to the fault plane(s), creating a ‘fault breccia’.

A fault is typically mapped as a single line but it may represent a single fault or several faults close together. If the fault is a single shear surface of minimal thickness this representation on a printed map might be a significant exaggeration. If, however, the geological interpretation suggested many fractures in a fault zone extending over say 50 m, it may also have to be depicted as a single line because of the cartographic limitations. In this case the published 1:50 000 fault line on the paper map would be narrower than the fault(s) on the ground. In the DiGMapGB data a fault line has no thickness and ideally is centrally placed on the actual fault at rockhead (or ground surface if the bedrock is exposed) so it is likely to be a better representation of a fault-line with a single shear plane than a fault zone with many shear planes.

In some areas, faults are exposed, or have been proved underground, for example, in tunnels or underground workings; in these cases, the existence of a fault is known, and the position of a mapped fault may be well constrained. However, in the majority of situations, faults recorded on the geological map were probably inferred by other evidence, including: linear depressions in the landscape, the truncation or displacement of topographical features, or the sudden change in geology proved by boreholes. If there are superficial deposits at surface then the position, nature and maybe even the existence of a fault recorded within the underlying bedrock may be highly conjectural. Faults are easier to identify and map in areas with large amounts of supporting evidence. Coal-fields typically have borehole and mine plan information that will aid the identification of faulted bedrock. This can result in more faults being mapped in coalfield areas, while areas where there is less geological information (for example, rural areas that have no history of mineral exploration) would typically have fewer mapped faults.

Faults encountered in coal mines were recorded as accurately as possible on mine plans. Faults would be extrapolated up towards the surface where appropriate, perhaps also using other supporting evidence (borehole or geophysical records), to map their position at surface or rockhead. In the absence of better information such faults are typically projected upwards at an inclination of 70 degrees, which is an assumed average for most British coalfields. If the inclination of the fault differs from 70 degrees then the mapped position of the fault on the geological map could be subject to an error of several tens of metres, or more, depending on the depth of the fault underground and the thickness of superficial deposits at the surface.

3.5.2 Folds

Many of the rocks forming the earth’s crust have been bent or deformed and the resulting strata tilted or inclined to form folds. They are best seen in layered sedimentary rocks where the bedding was originally planar. In the simplest examples these folds may have a rounded hinge zone with planar limbs to either side of the hinge; dipping outwards (in an upward arched anticline) or inwards (in a downwards or concave syncline). Simple folds have an axial plane about which the folding appears to have taken place. The trace of this axial plane on the bedrock surface runs parallel to the fold axis and may be shown on the geological map, dependent on the scale. Major folds that significantly affect the distribution of the rock outcrop, as mapped, are recorded. At 1:10 000 scale the wavelengths may be hundreds of metres; at 1:50 000 they may be kilometres; and at 1:625 000 tens of kilometres. There are many different types of folds but those that are only seen as small structures in individual rock exposures may not have been mapped.

On the geological map, fold axes form boundaries where the geological structure changes; for example they may mark a zone separating rocks in one area where they dip to the east from another where they dip to the west. In the UK, with limited rock exposure, most fold axes are inferred features rather than directly observed ones. Some uncertainty therefore attaches to their mapped positions and the linear features in the data are best regarded as approximate zones of change rather than well defined lines. Moreover the style of folding varies: in open folds the hinge is rounded and the hinge zone or axial trace therefore broad; in tight folds the hinge is relatively sharp and the hinge zone or axial trace correspondingly narrow.

4 Copyright and licensing

4.1 LICENCES AND OBTAINING DIGITAL DATA

The BGS does not sell digital map data; such data are made available to all users under non-exclusive, non-transferable licence agreements. There is a licence fee that entitles the licensee to use the data in-house for an agreed period of between one and five years. A complimentary licence can also be issued by arrangement for third party use. There are three components to the fee:

- Data usage charge [DUC]; variable fee depending on scale of the data, duration of the licence, area in square kilometres, and the number of licensed seats required.
- Licence administration charge [LAC]; a fixed fee currently of £150, which is applied each time a licence is issued or renewed.
- Data preparation charge [DPC]; generally this is a fixed fee, typically of £150 applied to each new licence, which also covers the supply of data. It may vary for different datasets and for any one dataset there may be more than one fee depending on how many preparations are required.

The total fee = DUC + LAC + DPC + VAT.

Areas are user-defined and need not conform to BGS sheet boundaries or the National Grid. There is no minimum, but orders for small areas are not cost effective because of the fixed LAC and DPC charges. Discounts are applied for large areas.

Users are the number of people that can access the data at the same time, also referred to as the number of seats, PCs or workstations. Discounts are applied to the data usage charge element for multiple users in price bands, as shown in Table 11.

Table 11 Discounts on data usage charges.

Band	1	2	3	4	5	6
Number of users	1	2–5	6–10	11–20	21–50	51–100
Data usage charges	1 x DUC	2 x DUC	3 x DUC	4 x DUC	5 x DUC	6 x DUC

Some examples of the licence fee chargeable, exclusive of VAT, are given in Table 12.

Table 12 Examples of DiGMapGB licence fees.

Scale	**Unit cost per square km**	**Example area in square km**	**Example DUC + LAC + DPC**	
			1 user 1 year	**1 user 5 years**
1:10 000	£1.50	25 (1 tile):	£337.5	£487.5
1:25 000	£0.60	100 (1 tile)	£358.8	£594
1:50 000	£0.20	560 (1 tile)	£412	£860
1:250 000	£0.006	10 000 (1 tile)	£360	£600

Fees can also be calculated for two, three or four year’s use.

1:625 000 scale DiGMapGB map data is available free of charge for all uses, including commercial, research and public use.

It can be downloaded at: http://www.bgs.ac.uk/downloads/browse.cfm?sec=6&cat=11. Where use is made of DiGMapGB-625 map data you must acknowledge the material (for details please see: http://www.bgs.ac.uk/about/copyright/acknowledgements_published.html).

All enquiries about the geographical coverage, availability or technical aspects of digital map data, data licensing and permitted data usage, and orders for the data required should be addressed to BGS Central Enquiries Desk (email: enquiries@bgs.ac.uk). DiGMapGB data are normally dispatched within 15 working days once the receipt of a signed licence has been confirmed. Please note that under a BGS Digital Data Licence, NERC accepts no responsibility for maintenance or technical support. Further information is available on the BGS website at: http://www.bgs.ac.uk/about/copyright/home.html

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4.3 IDENTIFYING DIGMAPGB DATASETS AND FEATURES

Published geological maps printed on paper were revised infrequently. However, the DiGMapGB datasets created from these maps are suitable for more frequent revision. This may be as a result of changes made to the geological interpretation (e.g. applying new nomenclature, adjusting linework, correcting errors, etc) or to the technical specification (e.g. digital format, level of attribution etc) or to the attached ancillary information (e.g. BGS Lexicon content).

Every dataset is uniquely identified by three pieces of information:

Dataset name +	Version-attribute +	Released date
e.g. DiGMapGB-50	V7.22	15-04-2013

Within the data each DiGMapGB feature from attribute level 19 onwards may also be referred to individually by their unique identifier (UUID).

Licensees are advised to use only the latest information available by ensuring they have the dataset or digital tiles with the latest version-attribute number and the most recent released date(s).

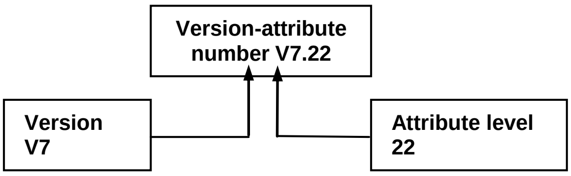
The **dataset name** is based on the scale of digital data appended to the DiGMapGB (Digital Geological Map of Great Britain) prefix thus:

DiGMapGB-10	is 10k	or 1:10 000 scale
DiGMapGB-25	is 25k	or 1:25 000 scale
DiGMapGB-50	is 50k	or 1:50 000 scale
DiGMapGB-250	is 250k	or 1:250 000 scale
DiGMapGB-625	is 625k	or 1:625 000 scale

The **version-attribute** number (e.g. V7.22) is embedded in the data and applies to the entire dataset.

The **released date** (e.g. 15-04-2013) is also embedded in the data. This is the date the data were created by BGS. It is updated for each new export of a particular DiGMapGB dataset and specifies the version precisely. When a new dataset is created all the map tiles will usually have the same released date. If a complete tile is changed it will be given a new released date on the date reprocessed and this will differ from the rest of the dataset. In exceptional circumstances an individual feature may have a different release date.

The **version-attribute number** consists of two parts as shown below:



The first part, the **version number**, refers to the overall number of the dataset; the first version released of a dataset is usually called Version 1 (or V1). Thereafter it is increased by one each time there is a new version released. The version number is attached as a suffix to the name of the dataset. Thus, after a major refitting exercise and revision of the geological nomenclature, the 1:50 000 scale data was upgraded from Version 1 (DiGMapGB-50 **V1**.xx) to Version 2 (DiGMapGB-50 **V2**.xx). Version 3 was released after a complete re-tiling of the data. These major changes to the dataset might be geological or technical. Versions 4 and 5 were released as annual updates, followed at two-year intervals by V6 (after a major restructuring of the master data) and V7.

The second part of the version-attribute number (separated by a stop or underbar depending on context) indicates the '**attribute level**' of the data. Thus the level of attribution of the first 1:50 000 scale dataset released was identified as **02** (e.g. DiGMapGB-50 V1.**02**). As the dataset was developed so the amount of ancillary information attached to the polygons and linear elements was increased and .02 was succeeded by **05**, **10**, **11**, **14**, **16**, **18**, **19** and **20** to the current attribution level, **22**. [The intervening numbers were used internally for development purposes but not published, apart from level **17** which has been used for the 1:625 000 scale dataset which has particular fields customised for OneGeology use].

The attribute level is important to GIS developers. Different datasets with the same attribute levels have the same types and level of information: thus a 1:10 000 scale dataset attributed to level 18 has the same information fields as a 1:50 000 scale dataset also with level 18 attributions. Applications developed for one attribute level of one dataset will work for another dataset with the same attribute level with few if any changes required to the programming. Applications needed to deal with data at a different attribute level e.g. 20 instead of 14 may require programme changes.

4.4 REFERRING TO DIGMAPGB DATASETS

References to BGS digital geological map datasets follow the format for paper publications as far as possible and ideally include the following:

- Primary responsibility: author or body
- Date: publication or date of copyright, span of dates, or latest date
- Title (+/- theme*): sufficient to identify the dataset
- Edition: version
- Place of publication: city or town
- Publisher: BGS
- (+/- Specific tile*)
- Release date

*optional as required

Within this framework it is possible to refer to the particular geological theme such as 'Bedrock' or 'Superficial' where necessary. Also one can refer to particular parts of a dataset by identifying the name/number of specific map 'tiles' of digital data as appropriate. Some examples are given below:

10k

British Geological Survey. 2005. Digital Geological Map of Great Britain 1:10 000 scale (DiGMapGB-10) data. Version 1.11. Keyworth, Nottingham: British Geological Survey. Tile TQ69SW. Release date 20-04-2005.

British Geological Survey. 2009. Digital Geological Map of Great Britain 1:10 000 scale (DiGMapGB-10) data. Version 2.18. Keyworth, Nottingham: British Geological Survey. Release date 15-01-2009.

25k

British Geological Survey. 2008. Digital Geological Map of Great Britain 1:25 000 scale (DiGMapGB-25) data. Version 2.18. Keyworth, Nottingham: British Geological Survey. Tile SN82. Release date 25-11-2008.

50k

British Geological Survey. 2005. Digital Geological Map of Great Britain 1:50 000 scale (DiGMapGB-50) data. Version 2.11. Keyworth, Nottingham: British Geological Survey. Tile EW257_Romford. Release date 14-04-2005.

British Geological Survey. 2006. Digital Geological Map of Great Britain 1:50 000 scale (DiGMapGB-50) data. Version 3.14. Keyworth, Nottingham: British Geological Survey. Tile EW196_Builth Wells. Release date 05-04-2006.

British Geological Survey. 2007. Digital Geological Map of Great Britain 1:50 000 scale (DiGMapGB-50) data. Version 4.16. Keyworth, Nottingham: British Geological Survey. Tile EW195_Lampeter. Release date 20-09-2007.

British Geological Survey. 2008. Digital Geological Map of Great Britain 1:50 000 scale (DiGMapGB-50) data. Version 5.18. Keyworth, Nottingham: British Geological Survey. Tile EW151_Welshpool. Release date 30-09-2008.

British Geological Survey. 2010. Digital Geological Map of Great Britain 1:50 000 scale (DiGMapGB-50) data. Version 6.20. Keyworth, Nottingham: British Geological Survey. Tile EW210_Fishguard. Release date 14-10-2010.

British Geological Survey. 2013. Digital Geological Map of Great Britain 1:50 000 scale (DiGMapGB-50) data. Version 7.22. Keyworth, Nottingham: British Geological Survey. Tile EW150_Dinas Mawddwy. Release date 15-04-2013.

250k

British Geological Survey. 2005. Digital Geological Map of Great Britain 1:250 000 scale (DiGMapGB-250) data. Version 4.11. Keyworth, Nottingham: British Geological Survey. Release date 15-11-2005.

625k

British Geological Survey. 2008. Digital Geological Map of Great Britain 1:625 000 scale (DiGMapGB-625), Bedrock data. Version 5.17. Keyworth, Nottingham: British Geological Survey. Release date 11-2-2008.

4.5 CONTACTS

Further information on all the digital data provided by the BGS can be found on our website at http://www.bgs.ac.uk/products/home.html or by contacting:

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email **enquiries@bgs.ac.uk**

Additional notes for the DiGMapGB datasets (Appendices A to E) are provided.

5 Glossary

DiGMapGB Digital Geological Map of Great Britain. Project established by BGS to digitise the geological map of Britain at a range of scales.

DiGMapGB-10 Digital Geological Map of Great Britain data at 1:10 000 scale.

DiGMapGB-25 Digital Geological Map of Great Britain data at 1:25 000 scale.

DiGMapGB-50 Digital Geological Map of Great Britain data at 1:50 000 scale.

DiGMapGB-250 Digital Geological Map of Great Britain data at 1:250 000 scale.

DiGMapGB-625 Digital Geological Map of Great Britain data at 1:625 000 scale.

SIGMA System for Integrated Geoscience Mapping. Project to design, develop and implement a methodology for the complete geological surveying process in BGS.

SIGMAdesktop Customised ArcGIS system capturing and visualising geological map data in the office. Creates integrated geological data, with attributes linked to tables, suitable for manipulation in a GIS. Formerly GSD (Geological Spatial Database) until rebadged in 2008.

6 References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The BGS library services are available online at: http://www.bgs.ac.uk/services/library/ including access to Envirolib, the Natural Environment Research Council library service catalogue. Many publications resulting from research within the work are now held within the NERC Open Research Archive (NORA) which can be accessed at http://nora.nerc.ac.uk/.

BUILDING RESEARCH ESTABLISHMENT (BRE). 1999. Radon: guidance on protective measures for new buildings. *Building Research Establishment Report*, BR211. ISBN 1 860813283.

COOPER, A H, KESSLER, H and FORD, J. 2006. A revised scheme for coding unlithified deposits (also applicable to engineering soils) British Geological Survey Internal Report, IR/05/123. 36pp.

FOLK, R.L. 1954. The distinction between grain size and mineral composition in sedimentary rock nomenclature. Journal of Geology 62, 344–359.

FORD, J, KESSLER, H, COOPER, A H, PRICE, S J and HUMPAGE, A J. 2010. An enhanced classification for artificial ground. *British Geological Survey Open Report*, OR/10/036.

FORD, J, KESSLER, H, COOPER, A H, PRICE, S J, HUMPAGE, A J, ALDISS, D T and SMITH, A. In preparation. An enhanced classification for artificially modified ground. *British Geological Survey Open Report*.

GILLESPIE, M R and STYLES, M T. 1999. BGS Rock Classification Scheme Volume 1, classification of igneous rocks. *British Geological Survey Research Report*, RR/99/06.

GILLESPIE, M R and STYLES, M T. In preparation. BGS Rock Classification Scheme Volume 1 (revised 2009): classifying and naming igneous material. *British Geological Survey Research Report*.

GILLESPIE, M R, CAMPBELL, S D G and STEPHENSON, D. In preparation. BGS classification of lithodemic units: a classification of onshore Phanerozoic intrusions in the UK. *British Geological Survey Research Report*, RR/12/01.

GILLESPIE, M R, STEPHENSON, D and MILLWARD, D. 2008. BGS classification of lithodemic units: proposals for classifying units of intrusive rock. *British Geological Survey Research Report*, RR/08/05.

HALLSWORTH, C R and KNOX, R O'B. 1999. BGS Rock Classification Scheme Volume 3, classification of sediments and sedimentary rocks. *British Geological Survey Research Report*, RR/99/03.

LESLIE, A G, KRABBENDAM, M and GILLESPIE, M R. 2012. BGS classification of lithodemic units: proposals for classifying tectonometamorphic units and mixed-class units. *British Geological Survey Research Report*, RR/12/02.

MCMILLAN, A A and POWELL, J H. 1999. BGS Rock Classification Scheme Volume 4, classification of artificial (man-made) ground and natural superficial deposits — applications to geological maps and datasets in the UK. *British Geological Survey Research Report*, RR/99/04.

ROBERTSON, S. 1999. BGS Rock Classification Scheme Volume 2, classification of metamorphic rocks *British Geological Survey Research Report*, RR/99/02.

SMITH, A. 2009a. Accuracy of BGS legacy digital geological map data. *British Geological Survey Research Report*, OR/09/064.

SMITH, A. 2009b. A new edition of the bedrock geology map of the United Kingdom. Journal of Maps, 2009, 232–252.

STYLES, M T, BAUER, W and ROBERTSON, S. In preparation. BGS Rock Classification Scheme Volume 2, (revised 2010): classifying and naming metamorphic rocks. *British Geological Survey Research Report*.

7 Web Links

BGS Home Page	www.bgs.ac.uk
BGS online shop	www.geologyshop.com
BGS digital products	http://www.bgs.ac.uk/products/home.html
BGS digital maps	http://www.bgs.ac.uk/products/digitalmaps/home.html
BGS DiGMapGB Information Notes	http://www.bgs.ac.uk/products/digitalmaps/dataInfo.html
BGS DiGMapGB 1:10 000 data	http://www.bgs.ac.uk/products/digitalmaps/digmapgb_10.html.
BGS DiGMapGB 1:50 000 data	http://www.bgs.ac.uk/products/digitalmaps/digmapgb_50.html
BGS DiGMapGB 1:250 000 data	http://www.bgs.ac.uk/products/digitalmaps/digmapgb_250.html.
BGS DiGMapGB 1:625 000 data	http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html.
BGS DiGMapGB-50 sample downloads	http://www.bgs.ac.uk/downloads/browse.cfm?sec=6&cat=12
BGS Intellectual Property Rights (IPR)	http://www.bgs.ac.uk/about/copyright/home.html
BGS 1:250 000 UTM maps	http://shop.bgs.ac.uk/Bookshop/UTMMaps.cfm
BGS Natural Hazards (GeoSure) data	http://www.bgs.ac.uk/products/geosure/home.html
BGS OpenGeoscience	http://www.bgs.ac.uk/opengeoscience/home.html
BGS GeoIndex	http://www.bgs.ac.uk/GeoIndex/
BGS Web Map Service (WMS)	http://www.bgs.ac.uk/geoindex/wms.htm
BGS Rock Classification Scheme	http://www.bgs.ac.uk/bgsrcs/home.html
BGS Lexicon of Named Rock Units	http://www.bgs.ac.uk/lexicon/home.cfm.
BGS Timechart	http://www.bgs.ac.uk/discoveringGeology/time/timechart/home.html?src=topNav
Digital National Framework (DNF)	http://www.dnf.org/
International Stratigraphic Chart	http://www.stratigraphy.org/index.php/ics-chart-timescale
NERC Open Research Archive (NORA)	http://nora.nerc.ac.uk/.
OneGeology portal	http://portal.onegeology.org/.
Open Government Licence	http://www.nationalarchives.gov.uk/doc/open-government-licence/

Appendix A DiGMapGB-10 data 1:10 000 scale

A1 DESCRIPTION OF THE DIGMAPGB-10 DATA

The DiGMapGB-10 dataset comprises digital geological map data at 1:10 000 scale. In the full dataset there are nominally about 11700 tiles, each a 5 x 5 km square based on the Ordnance Survey's National Grid. Currently some 3299 tiles are available covering about 28% of GB, with a further 17% in preparation. Work continues to extend the geographical cover, to include all large priority urban areas and road and rail transport corridors, where such data is needed to create high resolution derived geohazard products and geological models.

The 1:10 000 scale digital geological data typically comprises four polygon themes: Bedrock, Superficial, Mass Movement (landslides) and Artificial, as well as a Linear theme for faults and thin rock beds such as coals.

For availability see: http://www.bgs.ac.uk/products/digitalmaps/digmapgb_10.html.

The 1:10 000 geological interpretations provided by DiGMapGB-10 are the most detailed generally available from BGS. This is the scale at which most geological surveying is carried out in the field.

Topographical base maps are not included with the DiGMapGB data.

A2 SOURCES OF 1:10 000 INFORMATION

Each DiGMapGB-10 digital tile is typically based on the latest 1:10 000 or 1:10 560 (six-inch to one-mile) scale geological map. These geological maps are compiled on contemporary Ordnance Survey National Grid or County Series topographical base maps at 1:10 000 or 1:10 560 scale.

Currently about 59% (6890 maps) of GB is covered by National Grid geological maps. Full county maps cover 46% (mostly Scotland, northern England and the Isle of Man), and quarter county sheets cover 41% of the UK (mostly England and south Wales). Only about 5% of GB has no detailed geological mapping.

Changes may have been made to the original published geological map to create the digital map data but major revisions to the geological lines are generally avoided. Geological data relating to specific points, such as fossil localities and dip arrows, are captured by BGS and will be made available in the future.

The geological nomenclature was reviewed and revised, as far as reasonably possible, to conform to the most up-to-date accepted usage. The lithology of bedrock units and superficial deposits recorded for DiGMapGB-10 may differ slightly from those given for the same area in DiGMapGB-50, but they should generally fall within the description used for the DiGMapGB-50 data.

The sources of information specific to each DiGMapGB-10 digital tile are available.

A3 CAUTION ON USE OF 1:10 000 DATA

The 1:10 000 scale digital map data is the most detailed geological interpretation available but it is generalised nevertheless and should be used only as a guide to the geology, not as a site-specific geological plan based on detailed site investigations. The scale of the data is indicated by the nominal scale attribute (NOM_SCALE: 10000) embedded in the data. Do not over-enlarge the data; for example, do not use 1:10 000 nominal scale data at 1:5000, 1:2500 or 1:1250 working scale.

The original geological map interpretations were fitted to the Ordnance Survey (OS) topographical bases available at the time of survey, as indicated by the nominal topographic year attribute (NOM_OS_YR). The digital geological data do not necessarily fit other topographical bases, including more modern OS ones.

The cartographic accuracy is 1 mm on the 1:10 000 base map which equates to 10 m on the ground. For a more detailed discussion of 'accuracy' issues see Smith, 2009a.

Further details can be seen on the BGS website at:
http://www.bgs.ac.uk/products/digitalmaps/digmapgb_10.html

A4 DIGMAPGB-10 DATA RELEASES

Releases of the 1:10 000 scale DiGMapGB-10 data are summarised in Table A1. Although most new 1:10 000 maps were routinely produced digitally from about 1992, it was not until Version 1 of the 1:50 000 scale dataset was substantially complete that systematic work commenced to capture existing 1:10 560 and 1:10 000 geological maps retrospectively. At each new release the nomenclature was typically updated and any obsolete Lexicon names replaced.

Table A1 DiGMapGB-10 data releases.

VERSION	ATTRIBUTE LEVEL	YEAR	*COMMENT*
V1	11	2003	*550 tiles available*
		2004	*650 tiles available*
		2005	*750 tiles available*
		2006	*850 tiles available*
		2007	*1000 tiles available*
		2008	*1300 tiles available*
V2	18	2009	*1314 tiles available in new version released after dataset reprocessed with LEX-RCS*
		Jan 2010	*1756 tiles available with 442 new tiles and 31 changed tiles added to dataset*
		Sept 2010	*2487 tiles available with 621 new tiles and 194 changed tiles added to dataset*
		April 2013	*3299 tiles available with 812 new tiles and 78 changed tiles added to dataset*

A5 SUMMARY OF CHANGES TO 1:10 000 DATA

A5.1 Changes from DiGMapGB-10 Version 1 to Version 2 (2009)

The change from Version 1 to Version 2 reflected a major change in the coding of polygons and linear features from attribute level 11 to 18.

The LEX_ROCK codes were replaced by LEX_RCS codes with the lithology based on the hierarchical BGS Rock Classification Scheme. The superseded LEX_ROCK field was retained, to link back to previous versions of DiGMapGB, but demoted in the attribute list.

A5.2 Changes to DiGMapGB-10 Version 2

Having originally created Version 2 in 2009, three more batches of tiles were added to the dataset in 2010 and 2013 bringing the total released to 3299.

Appendix B DiGMapGB-25 data 1:25 000 scale

B1 DESCRIPTION OF THE DIGMAPGB-25 DATA

The DiGMapGB-25 dataset comprises digital geological map data at 1:25 000 scale. It is a partial dataset of 10x10 km tiles which complements the 1:10 000 scale DiGMapGB-10 data, and may substitute for it in selected areas where 1:10 000 scale mapping is not available. There is no intention to create national overage at 1:25 000 scale.

The 1:25 000 scale digital geological data typically comprises four polygon themes: Bedrock, Superficial, Mass Movement (landslides) and Artificial, as well as a Linear theme for faults and thin rock beds such as coals.

For availability see: http://www.bgs.ac.uk/products/digitalmaps/digmapgb_25.html.

Where there is 1:25 000 scale data (apart from special areas of classic geology) it is likely to be the most detailed data available. Most primary geological mapping was carried out at 1:10 000 scale but in some areas of Wales and Scotland mapping at 1:25 000 was adopted as the norm, for publication at 1:50 000. Where the geology is particularly complex, or in some areas of classic geology, 1:25 000 sheets may also be published, but there has been no retrospective capture to extend the DiGMapGB-25 cover.

Topographical base maps are not included with DiGMapGB data.

B2 SOURCES OF 1:25 000 INFORMATION

Each DiGMapGB-25 digital tile is typically based on the latest 1:25 000 scale geological map. These geological maps are compiled on contemporary Ordnance Survey National Grid topographical base maps at 1:25 000 scale.

Currently there are 51 maps published at 1:25 000 scale in the 'Classical Areas' of British Geology series. None have been digitised for DiGMapGB but the more recent ones were prepared digitally. They cover areas of outstanding geological interest, such as Church Stretton, Snowdon and Glen Coe, whose distribution is shown in the catalogue of maps, books and data available on the BGS website at: http://www.bgs.ac.uk/catalogue/home.html. They provide more detail than the published 1:50 000 maps and are custom designed to centre on a particular geographical area. Most are based on more detailed 1:10 000 or 1:10 560 (six-inch to one-mile) scale geological maps, and as a consequence they have not been digitised to create DiGMapGB-25 tiles as the source 1:10 000 or 1:10 560 maps could be used to create DiGMapGB-10 data.

In contrast there are about 52 tiles of 1:25 000 scale data produced by 'rapid mapping' surveys in parts of Central Wales, the Scottish Highlands and the Southern Uplands. These were carried out at 1:25 000 scale rather than the normal 1:10 000 scale in order to expedite completion of the 1:50 000 scale map series. It is unlikely that many of these areas will be revisited to survey in more detail in the near future and where DiGMapGB-25 remains the most detailed data available it will substitute for DiGMapGB-10.

Changes may have been made to the geological interpretation but major revisions to the geological lines have generally been avoided.

The geological nomenclature has been reviewed and revised, as far as reasonably possible, to conform to the most up-to-date accepted usage; usually this will also agree with the DiGMapGB-50 dataset. The lithology of bedrock units and superficial deposits recorded for DiGMapGB-25 may differ slightly from those given for the same area in DiGMapGB-50, but they should generally fall within the description used for the DiGMapGB-50 data.

The sources of information specific to each DiGMapGB-25 digital tile are available.

B3 CAUTION ON USE OF 1:25 000 DATA

The 1:25 000 scale digital map data is a moderately-detailed geological interpretation but it is generalised and should be used only as a guide to the geology, not as a site-specific geological plan based on detailed site investigations. The scale of the data is indicated by the nominal scale attribute (NOM_SCALE: 25000) embedded in the data. Do not over-enlarge the data; for example, do not use 1:25 000 nominal scale data at 1:5000, 1:2500 or 1:1250 working scale.

The original geological map interpretations were fitted to the Ordnance Survey (OS) topographical bases available at the time of survey, as indicated by the nominal topographic year attribute (NOM_OS_YR). The digital geological data do not necessarily fit other topographical bases, including more modern OS ones.

The cartographic accuracy is 1 mm on the 1:25 000 base map which equates to 25 m on the ground. For a more detailed discussion of 'accuracy' issues see Smith, 2009a.

Further details can be seen on the BGS website at:
http://www.bgs.ac.uk/products/digitalmaps/digmapgb_25.html

B4 DIGMAPGB-25 DATA RELEASES

Releases of the 1:25 000 scale DiGMapGB-25 data have generally followed the pattern set by DiGMapGB-10 data as summarised in Table B1; indeed for many practical purposes it has been treated as if an extension of the 1:10 000 scale data. Although most new 1:10 000 maps were routinely produced digitally from about 1992, it was not until Version 1 of the 1:50 000 scale dataset was substantially complete that systematic work commenced to capture existing 1:10 560 and 1:10 000 geological maps retrospectively. At each new release the nomenclature was typically updated and any obsolete Lexicon names replaced.

Table B1 DiGMapGB-25 data releases.

VERSION	ATTRIBUTE LEVEL	YEAR	*COMMENT*
V1	11	2005	*3 tiles available*
		2006	*12 tiles available*
		2007	*26 tiles available*
		2008	*32 tiles available*
V2	18	2009	*52 tiles available in new version released after dataset reprocessed with LEX-RCS*
		2012	*167 tiles available with 98 new and 17 changed tiles*

B5 SUMMARY OF CHANGES TO 1:25 000 DATA

B5.1 Changes from DiGMapGB-25 Version 1 to Version 2

The change from Version 1 to Version 2 reflected a major change in the coding of polygons and linear features from attribute level 11 to 18. Another batch of tiles was added to the data in 2012 to bring the total released to 167.

The LEX_ROCK codes were replaced by LEX_RCS codes with the lithology based on the hierarchical BGS Rock Classification Scheme. The superseded LEX_ROCK field was retained, to link back to previous versions of DiGMapGB, but demoted in the attribute list.

Appendix C DiGMapGB-50 data 1:50 000 scale

C1 DESCRIPTION OF THE DIGMAPGB-50 DATA

The DiGMapGB-50 dataset comprises digital geological map data at 1:50 000 scale. In the full dataset there are nominally 350 digital tiles for England & Wales and 150 for Scotland. The dataset is now almost complete and forms BGS's primary geological reference map. In Version 7 there are now just two areas with no data on any theme: EW118_Nefyn and EW180_Knighton For availability see: http://www.bgs.ac.uk/products/digitalmaps/digmapgb_50.html.

The tiles are based on the historic 'one-inch to one-mile' published maps with each one typically about 20 x 29 km and the tile boundaries inclined to the Ordnance Survey's National Grid.

The 1:50 000 scale digital geological data typically comprises four polygon themes: Bedrock, Superficial, Mass Movement (landslides) and Artificial, as well as a Linear theme for faults, thin rock beds such as coals, and landforms.

The master data from which the published ESRI or MapInfo files are derived are held in ESRI file geodatabase format.

The geology is generalised from detailed 1:10 000 scale maps and other sources by cartographical selection, modification, simplification or exaggeration and is the most extensive, moderately-detailed, geological interpretation available from BGS. It is widely used to create derived geohazard products.

Topographical base maps are not included with the DiGMapGB data.

C2 SOURCES OF 1:50 000 INFORMATION

Each DiGMapGB-50 digital tile is typically based on the latest 1:50 000 (or 1:63 360) scale geological map. For some maps, especially in areas of complicated geology, the Bedrock and Superficial (formerly 'solid' and 'drift') themes are published on separate map editions.

Some changes may have been made to the published lines to create the digital data but major revisions are generally avoided. The geological nomenclature was reviewed and revised, as far as reasonably possible, to conform to the most up-to-date accepted usage.

In exceptional cases, usually relating to older mapping where the published maps were seriously deficient, geological lines were imported from recent 1:10 000 or 1:25 000 scale maps. Those geological maps that were only available as paper copies were digitised for DiGMapGB-50. Recently published maps, compiled digitally, were reprocessed to the same standard. In some areas where there are no suitable geological maps published, new geological lines were compiled for DiGMapGB-50 by fitting the best available old linework to modern topographical bases. The sources of information specific to each digital tile are available.

The DiGMapGB-50 data includes a few tiles in Scotland that are based on 1:100 000 maps of the Orkney Islands and the Western Isles (Outer Hebrides). The smaller scale provides a more convenient base map and there is little consequent loss of detail in these areas of relatively simple geology. There may, however, be greater exaggeration of some features at 1:100 000, for example the width of intrusive igneous dykes, in order to depict them satisfactorily at this scale.

Where there are no DiGMapGB-50 tiles available BGS can supply 1:250 000 scale (DiGMapGB-250) Bedrock and 1:625 000 scale (DiGMapGB-625) Bedrock and Superficial digital data.

C3 CAUTION ON USE OF 1:50 000 DATA

The 1:50 000 scale digital map data is generalised and the geological interpretation should be used only as a guide to the geology at a local level, not as a site-specific geological plan based on detailed site investigations. The scale of the data is indicated by the nominal scale attribute (NOM_SCALE: 50000) embedded in the data. Do not over-enlarge the data; for example, do not use 1:50 000 nominal scale data at 1:10 000 working scale. If more-detailed information is required then the 1:10 000 scale maps or digital data, which provide the most-detailed interpretations available, should be consulted.

The original geological map interpretations were fitted to Ordnance Survey (OS) topographical bases available at the time of survey, as indicated by the nominal topographic year attribute (NOM_OS_YR). The digital geological data do not necessarily fit other topographical bases, including more modern OS ones.

The cartographic accuracy is 1 mm which equates to 50 m on the ground at 1:50 000 scale. This is a measure of how faithfully the lines are captured; it is not a measure of the accuracy of the geological interpretation.

For a more detailed discussion of 'accuracy' issues see Smith, 2009a.

C4 DIGMAPGB-50 DATA RELEASES

Releases of the 1:50 000 scale data as DiGMapGB-50 are summarised in Table C1. At each new release the nomenclature was typically updated and any obsolete Lexicon codes replaced.

Table C1 DiGMapGB-50 data releases.

VERSION	ATTRIBUTE LEVEL	YEAR	*COMMENT*
V1	02	2001	*First version released*
	05	2002	*Attribution improved by adding: version, release date, full parentage, age ranges, hierarchical age number, additional printing colours, scale and source (year) information*
	10	2003	*RCS codes added*
V2	10	2003	*Rationalisation of the nomenclature and a major exercise to reduce the number of misfits between adjacent digital map tiles*
	11	2004	*Geochronology replaced chronostratigraphy in attribution*
V3	14	2006	*Re-tiling the whole dataset to avoid gaps and overlaps between tiles. Other revisions, including the correction of errors and further updates to nomenclature. Previous names and ages in million years added. Attribution of linear features improved*
V4	16	2007	*Incorporating new and revised tiles and miscellaneous corrections. LEX_RCS and LEX_RCS_I added to attribution to aid automatic key generation*
V5	18	2008	*Incorporating new and revised tiles and miscellaneous corrections*
V6	20	2010	*Master data converted to customised ESRI® ArcGIS format and released after incorporating new and revised tiles created during the previous year as well as miscellaneous corrections. UUIDs added*
V7	22	2013	*Incorporating new and revised tiles, refits and miscellaneous corrections*

C5 SUMMARY OF CHANGES TO 1:50 000 DATA

C5.1 Changes from DiGMapGB-50 Version 1 to Version 2 (2003)

The change from Version 1 to Version 2 reflected a major refitting exercise of the Bedrock and Superficial themes (formerly 'solid' and 'drift' respectively) for all the DiGMapGB-50 data. Geologists re-examined all the 1:50 000 digital tiles and refitted each margin. Where practicable, minor misfits in the geological lines were removed, particularly where caused by the differences in cartographic compilation procedures rather than misfits in the original detailed 1:10 000 or 1:10 560 geological mapping. Typically, no attempt was made to remove major line-misfits between neighbouring tiles, usually caused by mapping of different ages and which are unlikely to be resolved until the relevant maps are resurveyed.

In addition, the polygon attributes or LEX_ROCK codes were reviewed. Obsolete and unnecessary names were removed, specific names given to some unnamed units, and some names updated. The stratigraphical framework of the Carboniferous, for example, was then undergoing a major revision and most of the new nomenclature was adopted for Version 2.

The lithology codes were rationalised to reduce the mosaic of lithological changes attached to the same geological unit on different tiles, which were not thought to represent real changes in lithology. For example the wide range of ROCK codes used for alluvium in Version 1 was reduced to a few in Version 2 on the basis that at 1:50 000 the data should be generalised and simplified. More detailed differences are retained in the 1:10 000 dataset. Many new composite lithology codes were created for a variety of mixed lithologies. However, their use presents a dilemma. If different codes are applied to reflect slightly different lithologies (e.g. sand and silty sand) on adjoining tiles this creates a misfit in the digital data, which may highlight trivial lithological changes from tile to tile. But if the same code is used to reflect the dominant lithology (e.g. sand) and create seamless data then significant geological detail may be lost. DiGMapGB seeks to provide a balance between detail and utility; neither over-simplicity nor excessive detail.

Version 2 data was initially attributed to level 10. In addition to the ROCK codes two new information fields (RCS and RCS_D) describing lithology were added to the data. RCS was an alternative code abbreviation (or a string of such codes joined by + signs with square brackets used for subordinate types), each up to 6 characters, for the type of rock or lithology as based on the hierarchical BGS Rock Classification Scheme (RCS): e.g. MDST + [CONG]. The description, RCS_D, for this is MUDSTONE + [SUBORDINATE] CONGLOMERATE.

The Artificial and Mass Movement themes were largely unaffected by this review apart from correcting obvious errors in coding. There was no attempt to update the coding or extent of artificial ground in the DiGMapGB data for the pragmatic reason that the surface of the ground is forever being modified by man and it is impossible to keep the theme up-to-date everywhere. DiGMapGB includes a 'snapshot' of the theme to show the artificial ground recorded at a particular time, usually the time of geological survey.

Similarly no attempt was made to update or refit the landslides shown in the Mass Movement theme because of their crucial importance in creating geohazard databases. It was thought prudent to modify these only on the basis of geological survey, preferably on the ground observation rather than a 'desk-top' revision.

Linear features such as coal seams and marine bands were included as the standard Linear theme in DiGMapGB-50 data, introduced with the release of Version 2_10.

The polygon data structure reflected by the '10' suffix (as in Version 1_10 and Version 2_10) is the same. This means that information fields attached to each polygon are the same, though the content of some of these fields may have changed as a consequence of continual upgrade to the

BGS Lexicon of Named Rock Units. Thus if the age of a rock unit is revised in the Lexicon then when the DiGMapGB data containing it are reprocessed this revised age is attached to all its polygons. As an increasing number of rock units are formalised so the revised Lexicon information will include improved hierarchical information allowing better analysis in GIS.

C5.2 Changes to DiGMapGB-50 Version 2 (2004)

Version 2 data were reissued at attribute level 11 reflecting mainly changes in how BGS refers to geological time in its databases. These were previously based on the BGS Chronostratigraphy Index, but the BGS Geochronology Index replaced this in 2004 (see section 3.4).

In the change from attribute level 10 to level 11 all information fields with names based on the chronostratigraphical terms (Eonothem, Erathem, System, Series and Stage) e.g. MAX_SYSTEM were replaced by new fields named after the geochronological equivalents (Eon, Era, Period, Epoch and Age) e.g. MAX_PERIOD. The vast majority of geological names remained the same in the new system. One exception is the Llandeilo Epoch (formerly of the same rank as the Llanvirn Epoch) which was reduced in rank to the Llandeilian Age and forms the later part of the newly extended Llanvirn Epoch.

DiGMapGB information fields with 'age' in the name in Version 2_10 (e.g. MAX_AGE, MIN_AGE) were replaced by names with 'time' in Version 2_11 (e.g. MAX_TIME, MIN_TIME). These are effectively the same, giving the oldest known geological date for the rock. The word 'age', as used here in the generic sense, was replaced by 'time' in order not to conflict with the specific time unit 'AGE' (e.g. MAX_AGE which replaced MAX_STAGE).

The Geochronology Index also shows the absolute age in millions of years for the start and end of each time unit, for example the Pennine Middle Coal Measures Formation of Duckmantian (Westphalian B) to Bolsovian (Westphalian C) age was deposited at some time between about 313 and 308 million years ago. Two new fields provide this information in DiGMapGB data as MAX_TIME_Y (313500000) and MIN_TIME_Y (308500000) using dates according to Gradstein and Ogg, 2004. Some values are interpolations between 'known' ages rather than direct measurements. These may have a recognised +/- potential error range, and be subject to further revisions as age-dating techniques are refined and geological understanding improved.

C5.3 Changes from DiGMapGB-50 Version 2 to Version 3 (2006)

The change from Version 2 to Version 3 reflected a major retiling of the data. In addition, all nodes in the data were redefined to an accuracy of 1 m (on the ground) replacing the previous [spurious] accuracy of 1 mm on the ground. The same tolerance was imposed on the tile margins so that each tile now has an outline precisely defined in terms of a one-metre grid. Because of the inclined nature of the 1:50 000 base maps the margins now have a series of fixed one-metre steps, and adjoining tiles have similar stepped margins which 'jigsaw' together. This eliminates minor overlaps and gaps that cause some GIS processing errors.

Some changes were made to the polygon labelling of the bedrock and superficial deposits for V3. The Lexicon attribution was reviewed, with some new terminology introduced and obsolete codes removed. Further minor changes were made to the lithology codes.

Version 3 was released as attribute level 14 with new information fields providing the previous names of units as listed in the BGS Lexicon of Named Rock Units. These names may have been used for all or part of particular polygons in particular areas as shown in DiGMapGB data, for example Keuper Marl and Keuper Series are two of the possible previous names used for the Mercia Mudstone Group.

The age range in years assigned to the relevant geological time period that the unit lies within is also provided.

The attribution of linear features was improved, although it is not yet complete. In Version 3 each line has a CATEGORY, for example Rock, Fault, Mineral_vein, Fold_axis, Fossil_horizon, Alteration_area, or Landform. The specific FEATURE within a category is identified (e.g. Coal_Inf) which is then described more fully in FEATURE_D (e.g. Coal seam, inferred).

Further, new information fields have been added containing more specific information such as the fault name, or mineral composition.

No attempt was made to update or refit the Artificial and Mass Movement themes; a few coding changes were made to particular polygons.

C5.4 Changes from DiGMapGB-50 Version 3 to Version 4 (2007)

In 2007, Version 4 of the 1:50 000 data was released, including the new or replacement tiles listed in Table C3 produced by resurvey or revision since the release of Version 3. It also incorporated minor revisions to correct errors reported by users throughout the year.

Table C3 New tiles for DiGMapGB-50 Version 4.

	V4 New tiles	***Comment***
Scotland	SC000_Solway East (special sheet) SC000_Solway West (special sheet) SC015e_Leadhills *[R] SC032e_Edinburgh *[R] SC032w_Livingston *[R] SC053w_Ardgour *[R] SC072e_Glen Affric (Superficial) SC080e_Portree *[R] SC080w_Dunvegan *[R] SC081w_Raasay *[R] SC090_Staffin *[R] SC093w_Ben Wyvis *[R]	*Geology extends into England* *Geology extends into England* - - - - - - - - - -
England & Wales	EW096_Liverpool *[R] EW186_Wellingborough *[R] EW194_Llangranog EW195_Lampeter EW207_Ipswich *[R] EW211_Newcastle Emlyn EW256_North London EW267_Newbury *[R] EW318_333_Brighton & Worthing *[R] EW319_334_Lewes & Eastbourne *[R]	- - - - - - - - - *(new combined sheet)*
	*[R] indicates new tile replaces earlier version	

Version 4 was released as attribute level 16 reflecting a change in the information fields supplied with the data. Previous versions of DiGMapGB-50 used the BGS.Dic_Rock_Type database for the ROCK codes in the LEX_ROCK pair classifying every polygon. In Versions 2 and 3 additional lithology fields using RCS (BGS Rock Classification Scheme) compliant codes were added.

In Version 4 of the data, RCS compliant codes based on the BGS Rock Classification Scheme (RCS) were used as the primary lithology to create the LEX_RCS pair labelling the polygons; whilst the 'LEX_ROCK' field was retained to provide a link with the older datasets.

The new fields in V4 were: RCS, RCS_X, LEX_RCS, LEX_RCS_I and LEX_RCS_D. The RCS_X field in V4 is similar to the RCS field in V3. It is the RCS lithology code (or string of such codes joined by + signs with square brackets used for subordinate types), each up to 6 characters: e.g. MDST + SDST.

The RCS field in V4 is either the single lithology code or a single abbreviated code for the string of codes in RCS_X. This short code is preferable to a long string of codes for checking the data on plots as it is more easily read, changes or errors are more easily recognised, and it is less prone to overprinting problems. In these respects it retains the simplicity of the original ROCK code whilst incorporating advantages of the hierarchical Rock Classification Scheme. The single codes and the abbreviated composite codes are all listed in the BGS.Dic_Rock_Sigma database. In addition to LEX_RCS (the two-part LEX & RCS code used to label each polygon of DiGMapGB data) LEX_RCS_D is a description of LEX_RCS and LEX_RCS_I includes the Maximum Index number, which can be useful when generating map keys.

C5.5 Changes from DiGMapGB-50 Version 4 to Version 5 (2008)

In 2008, Version 5 was released, including both new and replacement tiles completed before April 2008, as listed in Table C4. The 'geological fit' of the Bedrock and Superficial themes on these tiles with their neighbours was reviewed and where possible the geology re-fitted by making further changes to the margins of adjoining tiles. Furthermore, because a number of revised tiles are sourced from single-theme sheets some adjustments were also made to the geology on other themes in order to keep the various themes compatible, for example keeping the same coastal limits. Version 5 also incorporates a series of minor revisions to correct errors reported by users throughout the year. In total, changes were made to 220 England & Wales tiles and to 70 Scotland tiles.

Table C4 New tiles for DiGMapGB-50 Version 5.

	V5 New tiles	*Comment*
Scotland	SC000_Assynt (Bedrock) *[R] SC010W_Lochmaben (Bedrock) *[R] SC032W_Livingston (Superficial *[R] SC037W_Furnace (Bedrock) *[R] SC053W_Ardgour (Bedrock) *[R] SC072e_Glen Affric (Superficial) *[R] SC080E_Portree *[R] SC129_North Maven (Superficial, Mass *[R] Movement and Artificial) *[R]	*affects SC101E, 102W, 107E, 108W* *affects SC000 Solway West & East* *from joint edition* - *replacing a pre-publication tile* *replacing a pre-publication tile* *replacing a pre-publication tile* *from old map replacing simplified Superficial theme on the 2004 Bedrock edition*
England & Wales	EW027_Durham (Bedrock) *[R] EW039_Kendal (Bedrock) *[R] EW087_Barnsley *[R] EW151_Welshpool EW156_Leicester *[R]	- - - - -
*[R] indicates new tile replaces earlier version		

Version 5 data were issued at attribute level 18 with the LEX_RCS field promoted and the superseded LEX_ROCK field demoted but retained to provide a link back to previous versions of DiGMapGB.

The source information was improved so that where two different editions were used as source maps the field NOM_BGS_YR could be suffixed by 'B' for the Bedrock theme and by 'S' for the Superficial (Artificial and Mass Movement) information. Similarly, differing ages of the topographic bases on different published maps given in the NOM_OS_YR field could be suffixed by 'B' or 'S'. Where there is one source map the field use is unchanged.

C5.6 Changes from DiGMapGB-50 Version 5 to Version 6 (2010)

Version 6 was created in 2010 for public release in 2011, following restructuring of the data to conform to BGS SIGMA standards. This allows larger polygons to be created, particularly useful in the Superficial theme with extensive spreads of Till, for example. It also permits unique identifiers (UUIDs), as described below, to be added.

The new and replacement tiles completed before April 2010 incorporated into Version 6 are listed below in Table C5. Where possible, the 'geological fit' of these tiles with their neighbours was reviewed and the geology re-fitted by making further changes to the margins of adjoining tiles. In addition to incorporating about 100 corrections for the annual revision, to correct errors reported by users throughout the year, the positions of some 36 tiles in Scotland were moved, generally by between about 20 and 75 m, to correct previous spatial errors. In total, changes were made to 72 tiles in England and Wales and 43 in Scotland.

Table C5 New tiles for DiGMapGB-50 Version 6.

	V6 New tiles
Scotland	SC010W_Lochmaben (Superficial) *R SC014W_Ayr (Bedrock) *R SC016W_Moffat (Bedrock) *R SC021E_Millport *R SC029E_Dunoon *R SC064W_Newtonmore *R SC064E_Ben MacDui *R SC101E_Ullapool (Bedrock *R
England & Wales	EW009_Rothbury *R EW071_Selby *R EW076_Rochdale *R EW130_Wells next the Sea *R EW155_Coalville *R EW164_Llanidloes EW210_Fishguard EW212_Llandovery EW282_Devizes *R EW311_Wellington *R
*R indicates new tile replaces earlier version	

Version 6 was released within BGS at attribute level 19 with universal unique identifiers (UUIDs) added to each feature. Here they are essentially date and time stamps which can be used to identify features by the time of their creation. These are for use in quality assurance by BGS, and external customers can use them, for example, to identify specific polygons when reporting problems,

The definition of the British National Grid (BNG) projection has been changed for Version 6 which now uses the latest BNG where the Scale Factor is more precisely defined as 0.9996012717 rather than 0.999601272 used previously. With older GIS software such as ArcGIS9.2, this may have minor speed implications for both BGS and external users. The software may attempt to re-project the new data on the fly, hence a slower refresh. If so this may be resolvable with one of the following:

- Update GIS software (as ArcGIS9.3 can handle the BNG scale update automatically)
- Set older projects to use the new definition
- Provide users with projection files with the old definition

Prior to external release two new fields, LEX_WEB and RCS_WEB, were added to the data and the attribute level increased to 20. The UUID field was prefixed by 'bgsn_' to make it fully compatible with the Digital National Framework (DNF).

The LEX_WEB field is populated with a direct link to the definitions in the BGS Lexicon of Named Rock Units available on the BGS website. It was created by appending the Lexicon or LEX code to the end of the standard query 'http://www.bgs.ac.uk/Lexicon?lexicon.cfm?pub=' and embedding this in every polygon and line attributed with a LEX code. For example the link http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=GOG provides direct access to the definition for the Great Oolite Group (Lexicon code GOG).

Similarly, the RCS_WEB field is populated with a direct link to the individual definitions in the BGS Rock Classification Schemed available on the BGS website. It was created by appending the RCS code to the end of the standard query 'http://www.bgs.ac.uk/bgsrcs/rcs_details.cfm?code=' and embedding this in every polygon and line attributed with an RCS code. For example the link http://www.bgs.ac.uk/bgsrcs/rcs_details.cfm?code=MDST provides direct access to the definition for mudstone (RCS code MDST). Information is only directly available for single lithologies; information for composites can be accessed by appending the individual RCS code (as listed in RCS_X) to the query.

C5.7 Changes from DiGMapGB-50 Version 6 to Version 7 (2013)

Version 7 was released in 2013, following the incorporation of 10 new and 14 replacement tiles completed before September 2012 as listed in Table C6. Unless a single theme is specified these include both Bedrock and Superficial themes.

Table C6 New tiles for DiGMapGB-50 Version 7.

	V7 New tiles
Scotland	SC008E_Loch Doon (Superficial) *R SC016E_Ettrick (Bedrock) SC073W_Invermoriston (Superficial) SC084E_Nairn (Bedrock)*R SC092E_Loch Fannich (Bedrock) SC101E_Ullapool (Superficial) SC102W_Oykel Bridge (Bedrock) SC108W_Ben Hee (Bedrock)
England & Wales	EW039_Kendal (Superficial) EW075_Preston *R EW085_Manchester *R EW086_Glossop *R EW100_Sheffield *R EW112_Chesterfield *R EW150_Dinas Mawddwy EW167_Dudley *R EW174_Thetford EW203_Bedford *R EW224_242_Colchester_Brightlingsea EW247_Swansea *R EW265_Bath *R EW283_Andover *R EW310_Tiverton *R EW346_Newquay *R
*R indicates new tile replaces earlier version	

Where possible, the geology on these was re-fitted by making changes to the margins with adjoining tiles before adding them to the dataset for release. The nomenclature was updated for the Superficial theme in the Vale of York and East Anglia and the Bedrock theme of the Clyde Plateau Formation in Scotland. All ad hoc accumulated errors reported by users throughout the year were corrected. In addition a start was made to systematically refit the Bedrock theme for most of the tiles in Scotland (apart from those adjoining the forthcoming V7 tiles) together with many in England, but excluding the Carboniferous areas. Many of the solutions have yet to be included in the data.

The remaining spatial corrections to the errors affecting mainly Scottish tiles was completed by the repositioning of selected tiles in Scotland by between about 20 and 75 m. The LEX_ROCK field was dropped for V7 and the attribute level raised to 22.

Appendix D DiGMapGB-250 dataset 1:250 000 scale

D1 DESCRIPTION OF THE DIGMAPGB-250 DATASET

The DiGMapGB-250 dataset comprises onshore digital geological map data at 1:250 000 scale. It is a complete dataset of 100 x 100 km tiles which complements the offshore geological datasets at 1:250 000 scale: DigRock250 and DigSBS250.

The 1:250 000 digital geological data has just the Bedrock theme; there is no Superficial, Mass Movement or Artificial theme available onshore at this scale.

For availability see: http://www.bgs.ac.uk/products/digitalmaps/digmapgb_250.html.

The geology is generalised from more detailed 1:50 000 maps by cartographical selection, modification, simplification or exaggeration. Following release in 1996 it was widely used, initially by customers who needed full national cover, but almost all areas are now covered by the more-detailed 1:50 000 dataset.

Topographical base maps are not included with the DiGMapGB data.

D2 SOURCES OF 1:250 000 INFORMATION

Each DiGMapGB-250 digital tile is based on the latest BGS 1:250 000 scale UTM (Universal Transverse Mercator projection) bedrock or 'solid' geological map. This series was originally published between 1977 and 1993.

Details of the printed map sheet names, numbers and publication dates are available from the BGS online catalogue at: http://shop.bgs.ac.uk/Bookshop/UTMMaps.cfm

Most of the onshore areas were compiled in the 1980s and are based, primarily, on earlier more detailed 1:50 000 (and one-inch to one-mile) geological maps published in the preceding decades and dating from the 1870s through to the 1980s. Apart from a occasional new or revised sheets this is essentially a legacy map series with no plans for its systematic update.

The source 1:250 000 published maps have a chronostratigraphical classification but were reclassified, as far as possible, with a lithostratigraphical nomenclature for the digital data.

Some changes were made to the published lines to correct errors, improve the fit between maps, add formational boundaries or remove purely chronostratigraphical ones. The sources of information specific to each digital tile are available.

D3 CAUTION ON USE OF 1:250 000 DATA

The 1:250 000 scale digital map data is generalised and the geological interpretation should be used only as a guide to the geology at a regional level, not a local one. The scale of the data is indicated by the nominal scale attribute (NOM_SCALE: 250000) embedded in the data. Do not over-enlarge the data; for example, do not use 1:250 000 nominal scale data at 1:100 000 or larger working scale. If more-detailed geological information is required then the 1:50 000 or 1:10 000 maps or digital data, should be consulted.

The generalised geological lines were fitted to topographical bases compiled from Ordnance Survey 1:250 000 maps and Ministry of Defence, Joint Operations Graphic (JOG) sheets. The UTM series sheets were scanned and re-projected to OS British National Grid for digitising. The digital data were re-tiled in to 100 km squares and re-fitted to the OS Strategi® coastline. The digital data may not necessarily fit other topographic bases, including more modern OS ones.

The cartographic accuracy is 1 mm on the 1:250 000 base map which equates to 250 m on the ground.

D4 DIGMAPGB-250 DATA RELEASES

Releases of the 1:250 000 scale data as DiGMapGB-250 are summarised in Table D1. Where appropriate at each new release the nomenclature was updated and any obsolete Lexicon codes replaced.

Table D1 DiGMapGB-250 data releases.

VERSION	ATTRIBUTE LEVEL	YEAR	*COMMENT*
V1		1994	*Original dataset for internal use*
V2		1996	*First external release*
V3		1998	*Dataset retiled*
V4	11	2005	*Refitted to OS Strategi coastline and RCS codes added*

This is legacy data. Whilst it is maintained, and can be periodically reprocessed to provide additional or revised attribution in line with other DiGMapGB data, there has been no systematic revision of the geological boundaries to reflect the improved information now available in many areas as a result of more recent geological surveying. Currently there are no plans for a systematic revision.

D5 SUMMARY OF CHANGES TO 1:250 000 DATA

D5.1 Changes from Version 1 to Version 2 data (1996)

Version 1 data replicated the published maps as far as possible and included attribution for the lithology and chronostratigraphy. For the first external release as Version 2 data in 1996 the UTM tiles were refitted together, and the polygons relabelled with LEX_ROCK codes and a simple attribution. In order to do this, some minor changes and corrections were made to the linework including splitting chronostratigraphical polygons to create the appropriate lithostratigraphical polygons.

D5.2 Changes from Version 2 to Version 3 data (1998)

In 1998 the data were re-tiled in standard 100 x 100 km OS grid squares with the DCW (Digital Chart of the World) coastline.

D5.3 Changes from Version 3 to Version 4 data (2005)

For Version 4, the data were refitted to the Ordnance Survey’s 1:250 000 scale Strategi® coastline and the attribution improved to level 11. A new ‘RCS’ information field, with lithology codes based on the hierarchical BGS Rock Classification Scheme, was added to the data as an alternative to the ‘ROCK’ code.

Appendix E DiGMapGB-625 data 1:625 000 scale

E1 DESCRIPTION OF THE DIGMAPGB-625 DATASET

The DiGMapGB-625 dataset comprises digital geological map data at 1:625 000 scale. It provides coverage for all of England, Wales, Scotland and the Isle of Man. All of Northern Ireland is included in the latest data but parts of it were omitted from earlier versions.

The digital geological data has two main parts: first, bedrock geology (comprising separate Bedrock and Dyke themes, and a Linear theme for faults); and second, a Superficial theme for natural superficial deposits.

For further details see: http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html.

The geology is generalised from larger 1:50 000 scale data by cartographic selection, modification, simplification or exaggeration.

Topographical base maps are not included with the DiGMapGB data.

E2 SOURCES OF 1:625 000 INFORMATION

The principal sources, whether paper map or digital data, for the two main parts of the 1:625 000 scale data are described below.

E2.1 Bedrock geology Version 1 data from printed map

The original DiGMapGB-625 Bedrock Version 1 data were based on the 1:625 000 scale printed 'poster' map (north and south sheets) of the United Kingdom, Solid geology, 1979 (3rd edition) which was digitised retrospectively. Parts of Northern Ireland were not included on the published map and do not appear in the V1 data.

E2.2 Superficial deposits Version 1 data from printed map

The original DiGMapGB-625 Superficial Version 1 data were based on the 1:625 000 scale printed 'poster' (north and south sheets) of the United Kingdom, Quaternary geology map, 1977 (1st edition) which was digitised retrospectively. Parts of Northern Ireland were not included on the published map and do not appear in the V1 data (sometimes misleadingly referred to as V4).

For publication as poster maps both the bedrock and superficial geology interpretations were fitted to the Ordnance Survey 1:625 000 topographic bases available at the time of publication. However, the Bedrock and Superficial themes digitised from these maps do not necessarily fit the modern topography very well when used in a GIS. The bedrock and superficial geology maps formed a matched pair with the same coastline.

E2.3 Bedrock geology Version 5 data from digital data

A new 1:625 000 scale (5th edition) printed geological map of the United Kingdom, published in 2007, was prepared digitally and these data were then used to create the replacement DiGMapGB-625 Bedrock Version 5. Although this was the second Bedrock version released, it was labelled as V5 to indicate its association with the 5th edition printed map. This also coincided conveniently with the 'V5' being the latest source 1:50 000 data used.

For publication as poster maps (north and south sheets) the bedrock interpretation was printed on to a topographical base supplied by HarperCollins in 2005 with the geology refitted to their coastline.

The 1:625 000 Bedrock data were created from two main sources. The geology for England & Wales, Scotland and the Isle of Man is generalised directly from the 1:50 000 scale DiGMapGB-50 V3 data released in 2006 with ongoing revisions through to 2007 incorporating selective interpretations from new 50k maps, anticipating their release as V5 tiles in 2008. The data for Northern Ireland were derived by minor simplification from the 1:250 000 scale geological map of Northern Ireland, published in 2007. Holes in the 50k data were filled using information from other sources.

The generalisation process from 1:50 000 to 1:625 000 scale is described in some detail by Smith (2009). In brief, the 1:50 000 data were selected, grouped together and reclassified, primarily on the basis of their hierarchical classification in the BGS Lexicon of Named Rock Units. Particular well-developed subordinate lithologies, for example some sandstones and limestones in predominantly mudstone sequences, were also selected, as were various igneous extrusive lithologies such as basalt lava flows. Having selected the appropriate units in the 1:50 000 scale data, the geological lines delimiting these new polygons were then re-digitised following standard cartographic procedures involving modification, simplification or exaggeration. In this way small areas were deleted, combined with others, or enlarged (in order to retain them) as appropriate. Intricate geological boundaries were simplified. The 1:625 000 Bedrock polygons created were reattributed with LEX_RCS codes using lithostratigraphical nomenclature where possible, often at the group level.

E2.4 Superficial deposits Version 5 data from digital data

With no new printed edition of the Superficial Deposits paper map planned, DiGMapGB was tasked with creating replacement 1:625 000 data directly from the 1:50 000 scale data by the quickest and most efficient way possible. New Superficial data were needed for use with the V5 1:625 000 Bedrock data to provide 'surface' geology data suitable for download from the OneGeologyEurope web portal at: http://onegeology-europe.brgm.fr/geoportal/viewer.jsp.

The 1:625 000 Superficial data are compiled from two main sources: the latest available 1:50 000 data (together with other information used to fill in the 'holes') and the 1:250 000 published Quaternary map of Northern Ireland.

The source DiGMapGB-50 V5 data covers most of England & Wales, Scotland and the Isle of Man. Where there were no 1:50 000 data available, or it was known to be inadequate, additional information was obtained following some of the procedures used to create the DiGMapGB 'surface' data used in GeoSure applications. This uses DiGMapGB-50 as the basis and modifies it where necessary in specific areas to improve the peat and till coverage using, for example, the existing 1:625 000 Superficial data.

The data for Northern Ireland, the second major source, were derived from the 1:250 000 scale geological map of Northern Ireland, published in 1991. The 1:250 000 Quaternary data were already generalised and needed only minor grouping and LEX-RCS simplification. The polygons were simplified using FME (Feature Manipulation Engine) software to produce data consistent with that generalised from 1:50 000 data.

The aim was to prepare Superficial data with a similar number of deposits (about 10 reduced from about 500 in the 1:50 000 data) and a similar classification (litho-morpho-genetic) to that used on the published 1:625 000 Quaternary map. This reduction was carried out by grouping together similar units following instructions on a spread sheet: for example all river terrace deposits, including both those with generic-type names and those with a formal lithostratigraphy were reclassified as RTDU (River Terrace Deposits, undifferentiated).

Each new LEX unit was also reattributed with a single generalised RCS lithology. Adjoining polygons with the same LEX-RCS codes were merged together and the resulting polygon boundaries generalised using automated techniques based on FME software. Intricate boundaries were smoothed, and small or narrow polygons removed or exaggerated. This generalisation is an iterative process allowing the various LEX-RCS units to be prioritised and treated differently according to the desired outcome. After each stage the modified data were reviewed to see if the results were satisfactory; and if not, the generalisation rules or specifications modified until successfully completed and suitable data produced for use at 1:625 000 scale.

E2.5 Superficial deposits Version 6 data from digital data

The procedures used above were repeated using DiGMapGB-50 V6 as the main source, together with some improvements to the processing. The resulting 1:625 000 Superficial data were used internally to make an engineering geology map. It was hoped to be able to improve this provisional data sufficiently until suitable for external release as DiGMapGB-625 Superficial Version 6 data.

E2.6 Superficial deposits Version 7 data from digital data

DiGMapGB-625 Version 7 Superficial data were planned using DiGMapGB-50 Version 7 as the principal source.

E3 CAUTION ON USE OF 1:625 000 DATA

The 1:625 000 scale data may be used as a guide to the regional or national level, but should not be relied on for local geology. The scale of the data is indicated by the nominal scale attribute (NOM_SCALE: 625000) embedded in the data. Do not over-enlarge the data; for example, do not use 1:625 000 nominal scale data at 1:250 000 or larger working scale. If more-detailed information is required then the 1:50 000 or 1:10 000 scale maps or digital data, should be consulted.

The original geological map interpretations are fitted to topographical bases available at the time of publication, as indicated by the nominal topographic year attribute (NOM_OS_YR). The digital data do not necessarily fit other topographical bases, including more modern OS ones.

The cartographic accuracy is 1 mm which equates to 625 m on the ground for the 1:625 000 scale base map; for most practical purposes this can be rounded up to 1 km.

E4 DIGMAPGB-625 DATA RELEASES

Releases of the 1:625 000 scale dataset as DiGMapGB-625 are summarised in Table E1.

Table E1 DiGMapGB-625 data releases.

VERSION	ATTRIBUTE LEVEL	YEAR	*COMMENT*
V1		2001	*Bedrock theme released*
V1	10	2003	*Superficial theme released with LEX_ROCK attribution*
V5	17	2008	*New Bedrock theme released including dykes and faults (used to create 5th edition printed map)*
V5	(18)	2011	*Provisional Superficial theme (used for OneGeology Europe, based on DiGMapGB-50 V5)*
V6	(18)	2013	*Superficial theme based on DiGMapGB-50 V6 (used internally for Engineering Geology map, awaiting release)*
V7	Planned		*Superficial theme based on DiGMapGB-50 V7*

E5 SUMMARY OF CHANGES TO 1:625 000 DATA

E5.1 DiGMapGB-625 Bedrock Version 1

The original Bedrock theme had geological attribution replicating the names and descriptions of each unit shown on the printed map key, which are a mixture of lithostratigraphic, chronostratigraphic and lithological terms.

In 2001 the Bedrock theme was released as DiGMapGB-625 Version 1. This is now regarded as obsolete and no longer available.

E5.2 DiGMapGB-625 Superficial Version 1

The original Superficial theme had single feature geological attribution replicating the names/descriptions for each unit shown on the printed map key that are a mixture of morphogenetic and lithological terms.

In 2003, the Superficial theme was converted to LEX_ROCK attribution and released as DiGMapGB-625 Version 4 attributed to level 10.

E5.3 DiGMapGB-625 Bedrock Version 5.17

In 2008, new Bedrock data, used to create the 5th edition Bedrock Geology map of the UK, were released as the Version 5 dataset at attribution level 17. It has LEX_RCS codes and a field called 'AGE_ONEGL' which gives the age in a particular format specifically agreed for OneGeology use. It also includes a 'MAP_CODE' field which gives the alphanumeric label used on the printed map, for example J1 is used for early Jurassic strata.

Three themes relate to the bedrock geology: Bedrock (polygons), Dykes (polygons), and Faults (lines). The dykes are typically greatly exaggerated to about 0.5 mm wide on the paper map (500 m on the ground) in order to depict with colour fill at 1:625 000 scale. In order to provide a versatile bedrock layer for use in a GIS, the dykes are provided as a separate layer of polygons that can be switched off when not needed. This also allows the Bedrock theme to be viewed without leaving large 'holes' for the dykes.

For further details see:

http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html

E5.4 Provisional DiGMapGB-625 Superficial V5.18*

The data covered all of Northern Ireland unlike the previous version which omitted parts of it. This was derived from a published 1:250 000 scale Quaternary map of Northern Ireland.

*The stated attribution is at level 18 but it contains an extra field, BLOCK_NAME, which identifies the block of digital data used as the source for the DiGMapGB-625 Superficial data

E5.5 DiGMapGB-625 Superficial V6.18 (awaiting release)

After successfully creating 1:625 000 scale Superficial data at V5, similar procedures were followed to create a revised version in 2012 based on DiGMapGB-50 Version 6 containing 15 new tiles of 1:50 000 scale Superficial data. This was used internally for the engineering geology map at 1:625 000 scale with an external release planned for 2013.

*The stated attribution is at level 18 but it contains an extra field, BLOCK_NAME, which identifies the block of digital data used as the source for the DiGMapGB-625 Superficial data

E5.6 DiGMapGB-625 Superficial V7 data (planned)

It is planned to create Version 7 after the DiGMapGB-50 V7 data, the principal source, is released containing 20 new tiles of 1:50 000 scale Superficial data. Universal unique identifiers (UUIDs) will be added to each feature. These are essentially date and time stamps used to identify individual features. These are for use in quality assurance by BGS, and external customers can use them, for example, to identify specific polygons when reporting problems.

E5.7 Reference

SMITH, A. 2009. A new edition of the bedrock geology map of the United Kingdom. Journal of Maps, 2009, 232–252. Available online at: http://www.journalofmaps.com

Appendix F The development of digital geological mapping

The development of digital geological mapping and the DiGMapGB data are summarised below.

1968
The NERC (Natural Environmental Research Council), the BGS's (then the Institute of Geological Sciences) parent body, funded the establishment of an Experimental Cartography Unit at the Royal College of Art in London to investigate the use of new technologies in map making.

1971
The first geological map prepared using experimental digital linework was published (Abingdon, 1:63 360 scale, Sheet EW253).

1980
The Experimental Cartography Unit transferred to Swindon to form part of the NERC Unit for Thematic Information Systems (NUTIS) tasked with the development of geographical information systems and digital cartography.

1985
Part of NUTIS transferred to Keyworth to introduce digital cartography techniques to BGS. This was part of a NERC plan to distribute these new skills and technology around its component bodies. In parallel, Cartographic Services in the Edinburgh office were undergoing trials with digital scanning of manually prepared artwork for map production.

1986–88
The BGS developed Intergraph® CAD (computer aided design) and database systems into a cartographical map production system. Developments evolved from MicroVAX-based systems, to UNIX workstations and PCs running Microstation® software. Although usable in a GIS environment for limited geological map data analyses, it initially remained primarily a cartographical tool for routine map production comprising essentially a database of colour tables for printing.

1989
The first Digital Map Production System (DMPS89) was developed and introduced to Cartographic Services at BGS Keyworth and traditional cartographical methods were phased out. It had been developed over several years following the introduction of geographical information systems and was used primarily for the production of 1:50 000 scale paper maps in conjunction with a database that permitted the automation of many production routines and the standardisation of printing colours. Notably, it required each polygon to be digitally encoded for the first time and this was linked to a table containing names and descriptions of each geological unit as shown in the printed map key.

1990
The 1:250 000 scale UTM (Universal Transverse Mercator) series of 'solid geology' maps were amongst the first to be captured retrospectively, providing prototype vector data automatically from raster scans.

1991

The 1:625 000 scale paper 'poster' maps of the United Kingdom were digitised producing Bedrock (solid) and Superficial (Quaternary or drift) themes.

1992

A Digital Map Production System (using Intergraph® Unix workstations) for producing 1:10 000 maps was introduced in 1992 after two years of development work. The digital data model was extensively modified to allow the polygons and linework to hold comprehensive geological attributes, linking each feature to sets of tables or dictionaries, including the BGS Lexicon. Over 200 print-on-demand 1:10 000 scale maps were produced but the system was cumbersome and proved too slow and expensive to implement for routine work.

1994

The vector digital dataset was completed for the Bedrock at 1:250 000 scale. It had two themes, chronostratigraphy (or time based units) and a rudimentary lithology, reflecting the nomenclature and ornamentation of the onshore area of the published UTM series. The preparation of this dataset had been given priority, as this series was the only one covering the whole of Great Britain.

1996

Although new maps were digital the vast majority of 1:50 000 scale maps remained in analogue paper format only. A digitisation programme of these legacy maps was required for the whole country to have digital map coverage. Initial work on this retrospective digitisation took place with a commission from Kent County Council to prepare digital tiles from twelve 1:50 000 and 1:63 360 scale geological maps. The methods developed here served as a prototype for later work.

1997

A unified Digital Map Production System (DMPS97) became operational for PCs, using a similar data structure to that developed previously. This system delivered the geological attribution and dictionaries combined with the map production tools including colour management and map printing attributes. It became the process engine providing corporate DiGMapGB format for standard digital geological map data. It employed an integrated system of geological attribution and map production in which the same digital information was used across a range of scales to produce both the datasets for use in geographical information systems and the printed map. It also permitted the inclusion of additional geological information that might not be present on the printed map face.

1998

In late 1998 a draft of the Strategic Plan Paper (*BGS Beyond 2000 – A vision of the future*) was released. This established 1:50 000 scale data as a key layer for the forthcoming Digital Geoscientific Spatial Model (DGSM) programme.

The DiGMapGB (Digital Geological Map of Great Britain) project started with the task of producing national digital geological map data at a range of scales.

The national geological map dataset at 1:250 000 scale was enhanced and licensed to the first external commercial customer. This comprised data in standard 100 x 100 km tiles showing onshore bedrock reclassified as far as possible into lithostratigraphical and lithological (LEX_ROCK) units.

Digitisation of 1:50 000 scale maps continued with DETR government commissions to provide digital map data for selected areas for radon assessments. Meanwhile a national radon dataset based on 1:250 000 scale data was prepared, which underpinned building regulations, BR211 (Building Research Establishment, 1999).

In order to speed completion of the dataset an external agency was contracted to digitise legacy maps following trials and competitive tendering. Over the next three years all available BGS legacy 1:50 000 'paper-only' maps were digitised by a combination of in-house and external work.

1999

The first 1:50 000 scale vector digital data were licensed. Existing digital data were reformatted to new corporate standards and the digitisation of 1:50 000 scale Scottish maps started. The external agency completed the digitisation of about 125 maps.

The 1:250 000 data were fitted to a new coastline and released as a new version.

2000

There was a great increase in digital coverage as a result of a major effort to complete the 1:50 000 scale dataset as soon as possible and this led to a significant increase in data licensing.

2001

The first edition of the 1:50 000 scale dataset (DiGMapGB-50 Version 1) was released. This combined all the maps digitised retrospectively and the modern digitally prepared maps into a single dataset processed to the same corporate standards and using the same up-to-date geological nomenclature. The data were made available in a variety of GIS formats.

The offshore 1:250 000 Sea-Bed Sediments theme was completed.

The development of affordable powerful PCs and software began to make it practicable to place digital map data into geographical information systems on each licensee's desk. There, it could now be used with other types of information to analyse problems and aid decision-making in Governmental organisations and agencies at local, regional and national level, as well as commercial companies across a range of business, for planning, development and environment-related applications, notably contaminated land.

2002

The 1:50 000 scale dataset (340 out of a possible 356 tiles in England and Wales, and all 186 in Scotland) was reviewed and about half the tiles re-fitted, where possible, to remove unnecessary misfits between adjoining map sheets.

Digitisation of the 1:250 000 scale offshore bedrock commenced.

2003

About 10% of the 11 500+ theoretically possible 1:10 000 scale geological maps were in preparation or available as digital data. The numbers were increased rapidly, supported by in-house responsive mapping funds and external commissions.

The 1:50 000 scale dataset was reissued with the inclusion of linear features and changes to the traditional BGS terminology ('solid' was replaced by 'bedrock', and 'drift' by 'superficial deposits').

The 1:250 000 scale offshore Bedrock theme was completed and released as DigRock250.

2004

The second edition of the 1:50 000 scale dataset (DiGMapGB-50 Version 2) was released (initially as unapproved 'interim' data) after refitting the tile margins and further rationalisation of the nomenclature.

2005
A project was initiated to develop and advance the Digital Map Production System within ESRI® based GIS systems, to ensure integration with developing geological field survey techniques.

A second contract was let with an external agency to digitise about 250 maps at 1:10 000 (and 1:10 560) scale, including the map face data for the DiGMapGB-10 digital dataset, the generalised vertical sections (GVS) and title panel information.

Successful trials were completed of revised 1:50 000 data with redefined map tile boundaries to eliminate ‘sliver’ problems of micro-overlaps and gaps when processing these inclined tiles.

Preparation of a completely new 1:625 000 scale onshore Bedrock dataset direct from DiGMapGB-50 Version 2 by selection and simplification commenced.

2006
The external digitisation of 1:10 000 scale maps continued into a second year with about 450 maps digitised and approval procedures, using the ESRI® GIS system, developed.

A third edition of the 1:50 000 scale dataset (DiGMapGB-50 Version 3) was released. Special compilations for a small number of tiles, mainly in central and south Wales, were prepared based largely on photo-interpretations. These provided Superficial data for use in derived products such as the BGS GeoSure datasets which show geohazard information, especially for the insurance industry. The attribution of linear features such as coal seams and marine bands was improved.

Work continued on the new 1:625 000 scale onshore Bedrock data.

2007
In the third year of the external contract about 200 maps at 1:10 000 scale were digitised. In total there were over 1000 tiles, all from in-house work, released.

A new release procedure for the 1:50 000 scale dataset was introduced with DiGMapGB-50 Version 4, providing greater consistency and coordination between the DiGMapGB data and derived product datasets. Preliminary work was carried out to assess the conversion of the 1:50 000 dataset to the ESRI® format.

The new 1:625 000 scale Bedrock geology master data for the preparation of the new ‘poster’ maps of the UK was completed. This was derived directly from 1:50 000 scale data and so has higher spatial accuracy than previous data. There were preliminary discussions on the need for, and specification of, new 1:625 000 Superficial theme data.

2008
In the final year of the second external contract about 100 maps at 1:10 000 scale were digitised bringing the total captured externally to about 1000.

DiGMapGB-50 Version 5 was released incorporating changes made to the dataset in the previous year.

A start was made to digitise the offshore Quaternary theme at 1:250 000 scale.

The poster maps of the UK were published, followed by the release of the new 1:625 000 scale Bedrock data (from which they were derived) made freely available as a download over the web as both a KML download (Google Earth) and via the OneGeology portal at:
http://portal.onegeology.org/. [OneGeology is an international initiative of the geological surveys of the world and a flagship project of the 'International Year of Planet Earth'. Its aim is to create dynamic geological map data of the world available via the web].

A customised ArcGIS was established as the prime map production system at 1:10 000 scale.

2009

A new competitive contract was let, initially for three years, to continue the external digitisation of 1:10 000 scale maps. DiGMapGB-10 Version 2 was released with about 1300 tiles and another 1500 in progress.

A simplified Superficial theme at 1:625 000 scale was prepared from DiGMapGB-50 data for release on the web.

2010

OpenGeoscience was launched by BGS providing free online access to many of its materials at: http://www.bgs.ac.uk/opengeoscience/home.html including free viewing of 1:50 000 scale DiGMapGB data with limited attribution.

The 1:50 000 master data were converted to a customised ESRI® ArcGIS geodatabase format (branded as SIGMAdesktop by BGS). DiGMapGB-50 Version 6 was prepared for internal release and the preparation of derived products.

An enhanced and expanded DiGMapGB-10 Version 2 dataset was released with 1800 tiles.

The progressive migration of the digital map production procedures to an ESRI platform continued.

2011

DiGMapGB-50 Version 6 released externally. DiGMapGB-625 Bedrock theme re-released with revised attribution including unique identifiers.

2012

Most of the Bedrock 1:50 000 scale tiles in Scotland and many in England (apart from the Carboniferous units) were refitted and there was a concentrated effort to complete as many 'paper' maps in the pipeline as possible and to incorporate the digital data from these into the next release of DiGMapGB-50 in preparation.

2013

Another 800 plus tiles were released for the DiGMapGB-10 Version 2 dataset. DiGMapGB-50 Version 7 released externally. A new DiGMapGB-625 Superficial theme is in preparation. This is created primarily direct from DiGMapGB-50 by generalisation with the addition of other information in parts.

Future work

Much work remains to be done to improve the DiGMapGB datasets but as routine systematic geological mapping and the production of new printed paper maps is phased out so there is some uncertainty as to how this will be carried out in future. As the emphasis moves to the creation of 3D models so there may be an increase in the feedback of revised geological interpretations and new procedures will need to be developed.

The successful completion of the many remaining tasks depends not only on priorities and the availability of staff/time resources but also the adequacy of other databases, in particular the suitability of definitions in the BGS Lexicon of Named Rock Units and the availability of stratigraphic frameworks rationalising the nomenclature.

Further details on digital maps can be accessed at:
http://www.bgs.ac.uk/products/digitalmaps/home.html