British Geological Survey

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User Guide for the BGS Geology: 50k dataset (V8)

Geoanalytics and Data Modelling Directorate

Open Report OR/16/46

BRITISH GEOLOGICAL SURVEY

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Keywords

User Guide; BGS Geology: 50k; geology, map

Front cover

Image of the BGS Geology: 50k Bedrock geology V8

Bibliographical reference

ARMSTRONG, R. A., DALEY, D. L., LAWLEY, R., MYERS, A. H, SMITH, A. 2016. User Guide for the BGS Geology: 50k dataset (V8). *British Geological Survey Open Report*, OR/16/46. 25pp.

Keyworth, Nottingham British Geological Survey 2016

BRITISH GEOLOGICAL SURVEY

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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 at a range of scales. These digital products are known by the name ‘BGS Geology’ (formerly DiGMapGB). This guide is written for users of the 1:50 000 scale digital geological map data (BGS Geology: 50k) version 8, released in 2016. It describes the basic layout and content of the dataset and provides background information as to how this version of the dataset has changed compared with previous versions. A basic appreciation of Geographical Information System (GIS) terminology is needed to understand some of the information outlined here. Users should also familiarise themselves with some of the basic principles behind geological description of our landscape; further information about how BGS has made the geological map of Great Britain can be found on the BGS website at: http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html

Acknowledgements

The authors would like to thank the many individuals (past and present) in BGS including geologists; cartographers and GIS experts who have helped create, maintain and update the BGS Geology: 50k dataset.

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Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for earth science information and expertise. The BGS provides expert services and impartial advice in all areas of geoscience. Our client base is drawn from the public, private and education sectors both in the UK and internationally.

Our innovative digital data products aim to describe the ground surface and sub-surface across the whole of Great Britain. These digital products are based on the outputs of the BGS survey and research programmes and our substantial national data holdings. These data coupled with our in-house geoscientific knowledge are combined to provide products relevant to a wide range of users in central and local government, insurance and housing industry, engineering and environmental business, and the British public.

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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2 About the BGS Geology: 50k V8 dataset

2.1 BACKGROUND

The British Geological Survey provides digital geological maps as part of its 'BGS Geology' product line. Since its launch in 1998, BGS Geology (formerly known as DiGMapGB) has produced several versions of the 1:50 000 scale data and this guide relates to Version 8.24 released in 2016. Each version has included new and replacement content that reflects the ongoing work of the Survey to extend and improve its geological map coverage.

2.2 WHO MIGHT REQUIRE THIS DATA

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 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.

These datasets are available as vector data (in a variety of formats), 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.

2.3 WHAT THE DATA SHOW

The BGS Geology: 50k data provide a digital representation of the geology previously shown on the map face of the published 1:50 000 scale paper maps.

The data are arranged into four geological themes:

1. Bedrock (e.g. rocks and deposits laid down prior to 2.588 million years ago- but including the Crag Group)
2. Superficial (e.g. deposits laid down during the Quaternary Period)
3. Mass Movement (e.g. areas of landslide)
4. Artificial (e.g. areas of artificially modified ground)

And an additional component for:

5. Linear features (e.g faults)

Each theme is provided as a set of digital files that make up a GIS data layer. The Bedrock, Superficial, Mass movement and Artificial layers represent geological units as a series of polygons (with text attributes). The linear features layer represents features that are either non-polygonal (such as fault planes or geological lineaments and landforms) or features that are too small to be defined as polygons in the other layers (such as thin coal seams and fossil horizons).

Attribute information is provided for every record in each layer in tabular form, with each field of attribution specific to the layer and the characteristic of the feature being described. For example, attribution may include the age of a geological unit, or its lithology. Additional attribution is provided for in links to further resources (such as hyperlinks to BGS webpages) and also metadata about the dataset (e.g. the scale, version or release date of the data). Information about the types of geological attribution available in BGS Geology: 50k is provided in the field-descriptions section below. Users are advised to familiarise themselves with the data structure and the underpinning geological concepts as outlined in Tables 1-4 and Appendix 2.

2.4 HOW TO VIEW THE DATA

The vector files of the BGS Geology: 50k V8 dataset can only be viewed in a Geographic Information System (GIS) such as ArcMap, MapInfo or QGIS. GIS software is available from many vendors; free-to-use (open source) variants are available online. Typically, BGS supplies digital vector data in the ESRI ‘shape’ format (which is widely used), but vector data can also be provided in a range of other GIS and CAD formats (contact BGS for further details).

Simplified versions of the BGS Geology: 50k Bedrock, Linear and Superficial themes are also available to view (for free) via the BGS OpenGeoscience pages at: http://www.bgs.ac.uk/opengeoscience/home.html where there are links to an online digital map viewer.

Similar data can also be viewed using the ‘iGeology’ app for iPhone/iPad and Android, available via http://www.bgs.ac.uk/data/apps/home.html.

3 Technical information

3.1 DEFINITIONS

3.1.1 BGS Geology: 50k

The BGS Geology: 50k V8 dataset is BGS's primary national geological reference dataset. It is compiled from individual digital tiles of data which were based on the traditional 'one-inch to one-mile' and 1:50 000 scale, paper geological maps; with each one typically covering an area of 20 x 29 km (12 x 18 miles). Distance units reflect the original paper map coverages. Digital scans of these paper maps are mostly available through the online BGS map portal (http://www.bgs.ac.uk/data/maps/home.html).

The geology is generalised from more detailed field-surveyed maps (typically between 1:10,000 and 1:25,000 scales) and it is the most extensive, moderately-detailed, geological interpretation available from BGS for onshore Great Britain. It is used to create other BGS products such as GeoSure and BGS Civils.

BGS Geology: 50k does not include geological information such as Generalised Vertical Sections or cross-sections. These can be viewed on the original scans, but the user needs to be aware that the classification and nomenclature of geological units may differ from the original paper map. Topographical base maps are not included with BGS Geology: 50k data.

3.1.2 Themes and layers

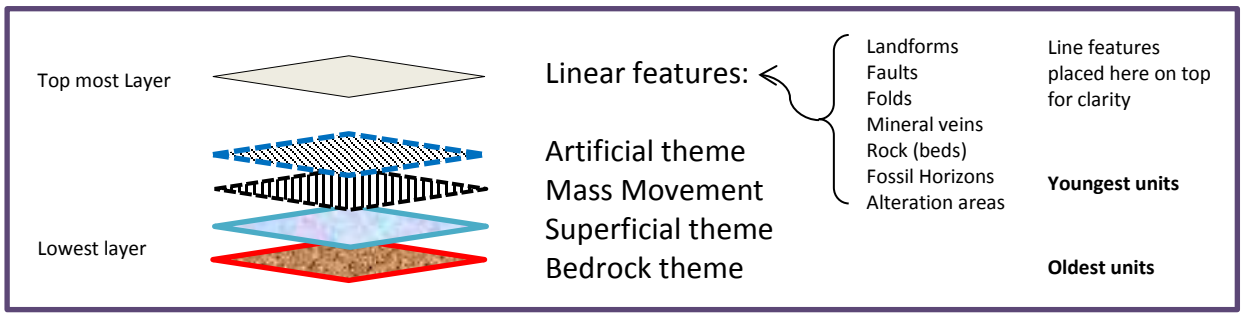
For this product there are 4 geological themes relating to: Bedrock lithologies, Superficial deposits, Mass movement deposits and Artificial deposits. The data is supplied as 5 or more GIS layers; there is one layer per geological theme and an additional layer supplied to cover linear features (which contains information relevant to the bedrock and superficial themes as well as topographic landforms).

3.1.3 Scale

BGS Geology: 50k is designed for use at approximately 1:50 000 scale.

3.2 DATA DESCRIPTION

The BGS Geology: 50k V8 dataset is provided as five GIS map layers. It is recommended that the layers are displayed in the following order within GIS (to allow best visualisation and clarity of the map objects):



Users should be aware that some layers are intrinsically related to each other, for example, the Faults features from the Linear layer are directly relevant to the Bedrock theme/layer; and the Mass-Movement theme/layer should be assessed in conjunction with the Superficial and Bedrock layers.

3.3 FIELD DESCRIPTIONS

Each geological theme (GIS map layer) contains a series of attribute fields. Attribution is specific to the theme/layer, for example, bedrock objects are attributed with lithostratigraphy, whereas geological faults (in the linear layer) are not. The following tables indicate the attributes available in each theme/layer. BGS aims to provide a balance between built-in content, web-delivered content as well as the potential for 'add-on' information/dictionaries.

This version of BGS Geology: 50k has different attribute content compared with previous releases. Further details about the changes are given in section 3.5 (Data History).

3.3.1 Attribution fields for the Bedrock and Superficial themes

The Bedrock and Superficial themes concern areas of geological materials and are typically attributed with descriptions for their name, age (expressed in multiple ways) and their lithology. The nomenclature for age and lithology are held in the BGS Lexicon of Named Rock Units (http://www.bgs.ac.uk/Lexicon/), and the BGS Rock Classification Scheme guides (http://www.bgs.ac.uk/bgsrcs/details.html).

The information fields attached to polygons (at attribute level 24) in these two themes are explained in Table 1 below.

Table 1 Attribution of Bedrock and Superficial Themes (GIS Layers)

DATA FIELD	EXPLANATION OF DATA FIELD	*Note*
LEX_WEB	Direct hyperlink to the definition of the particular geological unit in the BGS Lexicon of Named Rock Units (BGS website): e.g. http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=GOG	*Note 1*
LEX	A single Lexicon (or LEX) computer code 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	A description of the LEX code above, giving the full name of the unit(s): e.g. GREAT OOLITE GROUP is the full name of the unit coded as GOG	
LEX_RCS	The primary two-part, LEX & RCS, code used to label the geological units in BGS Geology data: e.g. GOG-LMST	*Note 3*
RCS	A rock-classification code of up to 6 characters (mostly letters) forming the second part of the primary LEX_RCS attribute. e.g. MDCO. The code can represent a single lithology or multiple lithology's (see RCS_X)	*Note 4*
RCS_X	A variant of the RCS code (above) which individually lists the components of heterolithic units: e.g. MDST + [CONG] (shown as RCS = MDCO). Subordinate units are denoted in [] brackets	*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]	
RCS_ORIGIN	An attribute of the RCS code(s) above, classifying the mode of origin of the lithology of the rock/deposit: e.g. Sedimentary, Igneous, and Metamorphic	*Note 6* ***New***
RANK	Rank of the unit in the lithostratigraphical or lithodemic hierarchy: e.g. BED or SUITE	*Note 7*
BED_EQ_D	Description of the Bed or equivalent lexicon code for the unit where applicable	
MB_EQ_D	Description of the Member or equivalent lexicon code for the unit where applicable	
FM_EQ_D	Description of the Formation or equivalent lexicon code for the unit where applicable	
SUBGP_EQ_D	Description of the Sub-Group or equivalent lexicon code for the unit where applicable	
GP_EQ_D	Description of the Group or equivalent lexicon code for the unit where applicable	
SUPGP_EQ_D	Description of the Super-Group or equivalent lexicon code for the unit where applicable	
MAX_TIME_Y	Maximum age (in years), of the oldest time division in which the geological unit was formed: e.g. 170300000	*Note 8*
MIN_TIME_Y	Minimum age (in years), of the youngest time division in which the geological unit was formed: e.g. 163500000	
MAX_AGE	Maximum age defined for the unit e.g. ASBIAN	*Note 9*
MAX_EPOCH	Maximum epoch defined for the unit: e.g. VISEAN	
MAX_SUBPER	Maximum sub-period defined for the unit: e.g. MISSISSIPPIAN	
MAX_ PERIOD	Maximum period defined for the unit e.g. CARBONIFEROUS	
MAX_ERA	Maximum era defined for the unit e.g. PALAEOZOIC	

MAX_EON	Maximum eon defined for the unit e.g. PROTEROZOIC	
BGSTYPE	The BGS Geology theme: e.g. BEDROCK, SUPERFICIAL	
LEX_RCS_I	A computer code that can be used to sort *units into* ***approximately*** *the correct stratigraphical order (by Period).* ***NB it does not completely resolve UK stratigraphy and must NOT be used as a substitute for determining full stratigraphical relationships between units.***	
LEX_RCS_D	A full description of the LEX_RCS above: e.g. GREAT OOLITE GROUP - LIMESTONE	
BGSREF	A BGS code used to define the colour for the polygon based on the LEX_RCS code pair. Colour information can now be applied from 'add on' tables in a variety of ways, please see Appendix 4	
MAP_SRC	Name of the 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	*Note 10* ***New***
MAP_WEB	The MAP_WEB link provides a direct hyperlink to the appropriate, original, paper maps held in the BGS Map Portal http://www.bgs.ac.uk/data/maps/home.html	*Note 11* ***New***
OS_TILE	Ordnance Survey 5km tile identifier. This is used to enable BGS Geology products to be updated in 5km tiles and allow integration into best-available scale maps (only available in the variant Ordnance Survey (OS) 5km tiled version of the dataset)	***New***
VERSION	Version number and attribute level of the digital data: e.g. 8.24 is version 8, with attribute level 24	
RELEASED	Date the BGS Geology data files were created by BGS: e.g. 28-07-2016	
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] **(see limitations section below)**	
NOM_BGS_YR	The year date of publication of the most up-to-date map sheet, or the date of publication in BGS Geology: 50k (if no map previously exists). Where not known or inappropriate, field is null	
UUID	Universally Unique Identification that can be used to identify individual features: e.g. bgsn:DM50_V8_digmap1004081046355357	

Fields in GREEN are derived from the BGS Lexicon	Fields in BLUE are derived from the BGS Rock Classification Scheme
Fields in PURPLE are derived from the BGS Geological timechart	Fields in brown are for metadata purposes

Note 1	*The LEX_WEB link provides a hyperlink to the* ***online Lexicon resource****. The online version is updated regularly.*
Note 2	*The Lex attribute is the computer code linking to the BGS Lexicon (database of named rock units) http://www.bgs.ac.uk/lexicon/home.cfm..The Lexicon code may refer to a single identifiable unit or a package of units where the individual components cannot be differentiated.*
Note 3	*The BGS Geology dataset uses the LEX_RCS codes as a primary key, which can be used to JOIN (append) 'add-on' datasets*
Note 4	*The RCS attribute is the computer code linking to the BGS Rock Classification Scheme (RCS) http://www.bgs.ac.uk/bgsrcs/home.html. The field may include abbreviated codes for multiple lithologies*
Note 5	*The RCS_X field provides a list of individual RCS lithology codes that make up the overall lithological description of the unit. The suffix _X was added to distinguish this listing of the components from the abbreviated code now shown in the RCS field.*
Note 6	*The origin of each rock/deposit type has been introduced in version 8, this is in part to assist users who wanted to know some fundamental properties of the geological materials* ***(see future revisions section below).***
Note 7	*The parentage of each rock/ deposit is provided in these fields and these are all derived from the BGS LEXICON. The 'RANK' of a unit identifies the units position within a hierarchy eg a 'bed' 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. The BED, MEMBER, FORMATION, SUBGRP GROUP and SUPGRP codes/names describe the ascending parentage for each unit (other non-stratigraphic schema are also shown in this way). A formation is the fundamental lithostratoigraphical unit and is the prime mapping-unit for BGS 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.* ***Users are recommended to refer to the LEX_WEB link to find the latest information concerning the lithostratigraphy of a unit****. All codes and names used in V8 are correct at time of publication.*
Note 8	*These figures give an indication of the maximum age range (in years before present) of the lithostratigraphical units as given in 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* ***(see future revisions section below).***
Note 9	*The maximum geochronological age (expressed as age/stage/chron, epoch, sub-period, period, era or eon) for each rock/ deposit is provided in these fields. These are all derived from the BGS Lexicon and Geological Timechart. 'NOT DEFINED' is used to indicate that no age classification has been identified (or is needed).* ***Users are recommended to refer to the LEX_WEB link to find the latest information concerning the lithostratigraphy of a unit****. Some geological units straddle more than one geological age. All codes and names used in V8 are correct at time of publication.*
Note 10	*This attribute was previously called SHEET. It has been changed in Version 8 to MAP_SRC, to reflect that BGS Geology is no longer just compiled from published map sheets, but from a range of sources.*
Note 11	*The MAP_WEB link provides a hyperlink to any online resource that acts as reference material for BGS Geology content. Currently, the weblink will take users to the appropriate, original, paper maps held in the BGS Map Portal http://www.bgs.ac.uk/data/maps/home.html (future versions will hyperlink to other resources).*

3.3.2 Attribution fields for Mass Movement and Artificial themes (GIS Layers)

The Mass Movement and Artificial themes concern areas of geological materials and are typically attributed with descriptions for their lithology and some limited information about their age. The information fields attached to polygons in these themes are explained in Table 2 below.

Table 2 Attribution of Artificial and Mass Movement Themes (GIS Layers)

DATA FIELD	EXPLANATION OF DATA FIELD	*Note*
LEX_WEB	Direct hyperlink to the definition of the particular geological unit in the BGS Lexicon of Named Rock Units (BGS website): e.g. http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=WMGR	*Note 1 Table 1*
LEX	A single Lexicon (or LEX) computer code used to identify the rock unit(s) or deposit(s) as listed in the BGS Lexicon of Named Rock Units: e.g. WMGR	*Note 2 Table 1*
LEX_D	A description of the LEX code above, giving the full name of the unit(s): e.g. WORKED AND MADE GROUND is the full name of the unit coded as WMGR	
LEX_RCS	The primary two-part, LEX & RCS, code used to label the geological units in BGS Geology data: e.g. WMGR-ARTDP	*Note 3 Table 1*
RCS	A rock-classification code of up to 6 characters (mostly letters) forming the second part of the primary LEX_RCS attribute. e.g. ARTDP. The code can represent a single lithology or multiple lithology's (see RCS_X)	*Note 4 Table 1*
RCS_X	A variant of the RCS code which individually lists the components of heterolithic units if appropriate: e.g. MUDSTONE + SANDSTONE (which would be coded as RCS = STMD). Subordinate units are denoted in [] brackets.	*Note 5 Table 1*
RCS_D	Description of the RCS code(s) above giving the lithology of the unit: e.g. ARTIFICIAL DEPOSITS is the description of the rock coded as ARTDP	
RCS_ORIGIN	An attribute of the RCS code(s) above, classifying the mode of origin of the lithology of the rock/deposit: e.g. Sedimentary	*Note 6 Table 1*
RANK	Rank of the unit in the lithostratigraphical or lithodemic hierarchy: e.g. LITHO-MORPHO-GENETIC (a classification by lithology, form or mode of origin, as applicable to such materials)	*Note 7 Table 1*
MAX_TIME_Y	Maximum age (in years), of the oldest time division in which the geological unit was formed: e.g. 2588000	*Note 8 Table 1*
MIN_TIME_Y	Minimum age (in years), of the youngest time division in which the geological unit was formed: e.g. 11000	
MAX_EPOCH	Maximum epoch defined for the unit: e.g. HOLOCENE (Artificial Materials are defined exclusively as Holocene)	*Note 9 Table 1*
MAX_ PERIOD	Maximum period defined for the unit e.g. QUATERNARY	
BGSTYPE	The BGS Geology theme: e.g. ARTIFICIAL, MASS MOVEMENT	
LEX_RCS_I	A computer code that can be used to sort *units into* ***approximately*** *the correct stratigraphical order (by Period).* ***NB it does not completely resolve UK stratigraphy and must NOT be used as a substitute for determining full stratigraphical relationships between units.***	
LEX_RCS_D	A full description of the LEX_RCS above: e.g. WORKED AND MADE GROUND – ARTIFICIAL DEPOSITS	
MAP_SRC	Name of the 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	*Note 10 Table 1*
MAP_WEB	The MAP_WEB link provides a direct hyperlink to the appropriate, original, paper maps held in the BGS Map Portal http://www.bgs.ac.uk/data/maps/home.html	*Note 11 Table 1*
OS_TILE	Ordnance Survey 5km tile identifier. This is used to enable BGS Geology products to be updated in 5km tiles and allow integration into best-available scale maps (only available in the variant OS 5km tiled version of the dataset)	
VERSION	Version number and attribute level of the digital data: e.g. 8.24 is version 8, with attribute level 24	
RELEASED	Date the BGS Geology data files were created by BGS: e.g. 28-07-2016	
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] **(see limitations section below)**	
NOM_BGS_YR	The year date of publication of the most up-to-date map sheet, or the date of publication in BGS Geology: 50k (if no map previously exists). Where not known or inappropriate, field is null	
UUID	Universally Unique Identification that can be used to identify individual features: e.g. bgsn:DM50_V8_digmap1004081046355357	

Fields in GREEN are derived from the BGS Lexicon	Fields in BLUE are derived from the BGS Rock Classification Scheme
Fields in PURPLE are derived from the BGS Geological timechart	Fields in brown are for metadata purposes

3.3.3 Data structure and attribution fields for the Linear Layer

BGS Geology: 50k includes a linear layer to portray geological concepts that are normally depicted in linear form e.g. natural lineation (features that are naturally lines, rather than polygons), intersections of surfaces/planes (that form a 'line' in 3d space) and cartographic/geologic generalisations of thin polygons (best represented as a 'line' at some scales).

The Linear layer is typically supplied as a single GIS layer, comprising specific categories of line feature (see table 3 below). BGS can supply the separate categories of linear features on request.

Table 3 Linear features described by category

Category	Description
FAULT	Lines representing planes of structural movement such as: normal faulting or thrusts. Relevant to the Bedrock theme.
MINERAL_VEIN	Lines representing the surface expression of mineralised fractures/veins Relevant to the Bedrock theme.
FOLD_AXIS	Lines representing planes of structural change/symmetry such as: anticline or syncline Relevant to the Bedrock theme.
ALTERATION_AREA	Lines that represent the spatial limit of alteration e.g. metamorphic aureoles or vein swarms. Relevant to the Bedrock theme.
ROCK	Lines representing thin beds of notable geological materials e.g. Coal, gypsum, ironstone Relevant to the Bedrock theme.
FOSSIL_HORIZON	Lines representing surfaces/beds of fossil zonation e.g. marine bands or fish beds Relevant to the Bedrock theme.
LANDFORM	Lines that represent landform features e.g. dune crestline or channel margin Relevant to all themes and topography.

3.3.4 Attribution fields for the Linear layer

The Linear layer is attributed to describe the various parameters associated with the 7 categories. Attribution is specific to each subcategory. For example, the Rock and Fossil Horizon categories of the Linear layer concern geological materials and are typically attributed with descriptions for their lithology and age (as per the Bedrock theme); whilst the Fault category may be attributed with a name or hanging-wall notation. Therefore, only some attribute fields are relevant to each category (and are irrelevant to others). Table 4 below, indicates the attributes available.

Table 4 Attribution fields of the Linear layer

DATA FIELD	EXPLANATION OF DATA FIELD	*Note*
CATEGORY	Geological unit category e.g. ROCK, FOSSIL_HORIZON	
FEATURE	The type of line feature/geological feature, in coded and abbreviated form, e.g. Coal_seam_Obs; Ironstone_bed_Inf	
FEATURE_D	Full description of the type of line feature e.g. Coal seam, observed; Ironstone bed, inferred	
LEX_WEB	Direct hyperlink to the definition of the particular geological unit in the BGS Lexicon of Named Rock Units (BGS website): e.g. http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=AGMB	*Note 1 Table 1*
LEX	A single Lexicon (or LEX) computer code used to identify the rock unit(s) or deposit(s) as listed in the BGS Lexicon of Named Rock Units: e.g. AGMB	*Note 2 Table 1*
LEX_D	A description of the LEX code above, giving the full name of the unit(s): e.g. Aegiranum Marine Band is the full name of the unit coded as AGMB	

LEX_RCS	The primary two-part, LEX & RCS, code used to label the geological units in BGS Geology data: e.g. AGMB-MDST For this layer, the LEX-RCS code acts as a secondary key to the FEATURE_D description of the line	*Note 3 Table 1*
RCS	A rock-classification code of up to 6 characters (mostly letters) forming the second part of the primary LEX_RCS attribute. e.g. MDCO. The code can represent a single lithology or multiple lithology's (see RCS_X)	*Note 4 Table 1*
RCS_X	A variant of the RCS code (above) which individually lists the components of heterolithic units: e.g. MDST + [CONG] (shown as RCS = MDCO). Subordinate units are denoted in [] brackets	*Note 5 Table 1*
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]	
RCS_ORIGIN	An attribute of the RCS code(s) above, classifying the mode of origin of the lithology of the rock/deposit: e.g. Sedimentary, Igneous, Metamorphic	*Note 6 Table 1*
RANK	Rank of the unit in the lithostratigraphical or lithodemic hierarchy: e.g. BED or SUITE	*Note 7 Table 1*
BED_EQ_D	Description of the Bed or equivalent lexicon code for the unit where applicable	
MB_EQ_D	Description of the Member or equivalent lexicon code for the unit where applicable	
FM_EQ_D	Description of the Formation or equivalent lexicon code for the unit where applicable	
SUBGP_EQ_D	Description of the Sub-Group or equivalent lexicon code for the unit where applicable	
GP_EQ_D	Description of the Group or equivalent lexicon code for the unit where applicable	
SUPGP_EQ_D	Description of the Super-Group or equivalent lexicon code for the unit where applicable	
MAX_TIME_Y	Maximum age (in years), of the oldest time division in which the geological unit was formed: e.g. 170300000	*Note 8 Table 1*
MIN_TIME_Y	Minimum age (in years), of the youngest time division in which the geological unit was formed: e.g. 163500000	
MAX_EPOCH	Maximum epoch defined for the unit: e.g. VISEAN	*Note 9 Table 1*
MAX_ PERIOD	Maximum period defined for the unit e.g. CARBONIFEROUS	
BGSTYPE	The BGS Geology theme: e.g. LINEAR	
LEX_RCS_I	A computer code that can be used to sort *units into* ***approximately*** *the correct stratigraphical order (by Period).* ***NB it does not completely resolve UK stratigraphy and must NOT be used as a substitute for determining full stratigraphical relationships between units.***	
LEX_RCS_D	A full description of the LEX_RCS above: e.g. GREAT OOLITE GROUP - LIMESTONE	
BGSREF	A BGS code used to define the colour for the LEX_RCS code pair. Colour information can now be applied from 'add on' tables in a variety of ways, please see Appendix 4	
FLTNAME_D	The name of the fault if available: e.g. Highland Boundary Fault	
HWALL_ROSE	Indicates the side of the fault that is the "Hanging wall". The side is depicted as a octant on a compass rose: (North, North east, East, South east, South, South west, West, North West) e.g. East indicates the hanging wall is on the eastern side of the fault trace; Faults yet to be characterised are shown as 'not-assessed'	
MINERAL_D	The name of the primary mineral identified, if available: e.g. GYPSUM	
MAP_SRC	Name of the 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	*Note 10 Table 1*
MAP_WEB	The MAP_WEB link provides a direct hyperlink to the appropriate, original, paper maps held in the BGS Map Portal http://www.bgs.ac.uk/data/maps/home.html	*Note 11 Table 1*
OS_TILE	Ordnance Survey 5km tile identifier. This is used to enable BGS Geology products to be updated in 5km tiles and allow integration into best-available scale maps (only available in the variant OS 5km tiled version of the dataset)	
VERSION	Version number and attribute level of the digital data: e.g. 8.24 is version 8, with attribute level 24	
RELEASED	Date the BGS Geology data files were created by BGS: e.g. 28-07-2016	
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] **(see limitations section below).**	
NOM_BGS_YR	The year date of publication of the most up-to-date map sheet, or the date of publication in BGS Geology: 50k (if no map previously exists). Where not known or inappropriate, field is null	
UUID	Universally Unique Identification that can be used to identify individual features: e.g. bgsn:DM50_V8_digmap1004081050156465	

Fields in GREEN are derived from the BGS Lexicon	Fields in BLUE are derived from the BGS Rock Classification Scheme
Fields in PURPLE are derived from the BGS Geological timechart	Fields in brown are for metadata purposes

3.4 HOW THE DATASET WAS CREATED

BGS Geology: 50k is a compilation of digital map tiles made by BGS from previously published paper maps at 1:50 000 or 1:63 360 scale (and some 1:100 000 scale data for Orkney and the Western Isles in Scotland). It includes additional survey and archive data (various ages and scales) derived from ongoing survey activities. Previous paper maps are now available online at the BGS Map Portal (http://www.bgs.ac.uk/data/maps/home.html), an appropriate hyperlink (the MAP_SRC field) is provided in BGS Geology: 50k V8 for each map object to guide the user to the most likely source(s) of archive map material.

Each object in BGS Geology: 50k is attributed with a LEX_RCS identifier or Category/Feature type as explained in Tables 1 to 4.

The digital data may now differ from the original paper maps for a number of reasons, for example: digital data is often modified to improve the fit between source datasets; nomenclature is updated to approved new/revised stratigraphical schemes; errors on printed maps are corrected; and new geological interpretations are made as part of BGS' remit to provide geological advice to the public and government.

3.5 DATA HISTORY

This is Version 8 of the data (attribute level 24). It incorporates new and revised tiles of data, OS opendata coastline and miscellaneous corrections to features across the country.

Locations of geological map modifications as a result of mapping, modelling or new evidence are shown in appendix 2 and include new mapping from the following geological sheets:

EW049 Kirkby Lonsdale
EW084 Wigan
EW118 Nefyn
EW125 Derby
EW147 Aylsham
EW266 Marlborough
EW330, 331, 344, 345 Isle of Wight

SC046e Killin bedrock edition
SC046w Crianlarich bedrock edition
SC051e_052w North Mull and Ardnamurchan
SC054e Loch Rannoch bedrock edition
SC074e Aviemore superficial edition
SC084e Nairn superficial edition
SC108w Ben Hee
SC102w Oykel Bridge superficial edition

There have been areas of data refinement associated with coastal areas (to incorporate the OS Open Data™ coastline, as well as for near-shore data around the Rivers Dee, Mersey and Thames. Mapping in the vicinity of the proposed High Speed 2 Rail link (London to Birmingham), has also been improved.

BGS Geology: 50k V8 incorporates over 130,000 edits since V7.22. The distribution of map-face changes are shown in Appendix 2. The underlying databases include updates to the BGS Lexicon (in terms of British stratigraphy and age/epoch/period time scales).

The attribute tables have been modified to include:

- a new field for RCS_ORIGIN (e.g. Sedimentary, Igneous, Metamorphic)
- a new field for hyperlinks to the BGS Map Portal
- a new optional field for OS 5km tile identification (when data is supplied in 5km tiles)
- a new field (Linear layer) for identifying Fault Hanging Wall orientation
- a changed field for map source (MAP_SRC), Field was formerly called 'SHEET'.

The database has also been restructured slightly so that field lengths are reduced where possible to reduce file size, improve performance on older PC's, and improve translation outcomes when converting between different file formats.

3.5.1 Deprecated attribute fields:

This version of BGS Geology: 50k has different attribute content compared with previous releases. Several fields within previous releases of BGS Geology: 50k contained data better delivered by web content; or via 'add on' datasets.

The deprecated (discontinued) fields include the following:

RCS_WEB, BED_EQ, MB_EQ, FM_EQ, SUBGP_EQ, GP_EQ, SUPGP_EQ, MAX_INDEX, MIN_INDEX, MIN_AGE, MIN_EPOCH, PREV_NAME, MIN_PERIOD, MIN_ERA, MIN_EON, MIN_SUBPER, BGSREF_LEX, BGSREF_FM, BGSREF_GP, BGSREF_RK.

These fields have been deprecated because they generally represent 'codes' (requiring further user computation) and/or use web-enabled content that is already available within the dataset via the LEX_WEB field.

All deprecated attributes are now supplied as a separate 'add-on' reference dataset (in ascii CSV format). These 'add on' attributes can be easily reapplied to BGS Geology: 50k V8 if users need them. There is further information relating to how to use 'add-on' content in Appendix 4.

3.6 COVERAGE

Data availability at 1:50 000 scale is shown in Appendix 3.

The BGS Geology: 50k dataset covers almost the whole of England, Wales and Scotland. In Version 8 there is now only one map tile with no data on any theme: EW180_Knighton.

Where there is no cover for a theme at 1:50 000 scale, smaller scale 1:250 000 (Bedrock) or 1:625 000 (Bedrock and Superficial) data are available.

3.7 DATA FORMAT

The data are typically released in ESRI Arc® shape file formats. Other formats such as MapInfo TAB are available on request. Both these formats are usable in free applications such as QGIS.

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

3.8 LIMITATIONS

BGS Geology: 50k is a compilation of digital tiles derived from previously published and unpublished maps and archive information. The mapping, description and classification of rocks are based upon the interpretations and evidence available at the **time of survey**, or time of re-evaluation for modifications/correction. The BGS Geology: 50k dataset therefore represents data of different vintages and origins. This means that it may not always agree with more recently gathered observation (such as boreholes) and that adjacent geological sheets/tiles (of different survey vintages) may not seamlessly fit together spatially, or in terms of lithological description (resulting in some map-sheet 'edges' that exhibit contrasting colours/attribution).

The original geological map interpretations were fitted to Ordnance Survey topographical bases available at the time of survey. The digital geological data do not necessarily fit other topographical bases including more modern Ordnance Survey ones.

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

Your use of any information provided by the British Geological Survey ('BGS') is at your own risk. Neither BGS nor the Natural Environment Research Council gives any warranty, condition or representation as to the quality, accuracy or completeness of the information or its suitability for any use or purpose. All implied conditions relating to the quality or suitability of the information, and all liabilities arising from the supply of the information (including any liability arising in negligence) are excluded to the fullest extent permitted by law.

No advice or information given by BGS, NERC or their respective employees or authorised agents shall create a warranty, condition or representation as to the quality, accuracy or completeness of the information or its suitability for any use or purpose.

3.9 FUTURE DEVELOPMENT

This version (V8) has introduced some changes to the structure of the BGS Geology: 50k dataset. This is to allow additional capabilities in future versions as well as facilitate and test the next generation of geological data products. The following section outlines proposed future development of the BGS Geology range of products:

Multiscale mapping (best available scales): These are maps that use the highest resolution of mapping available. Typically this will be a combination of 1:10 000, 1:25 000 and 1:50 000 scales. Maps will be provided in 5km tiles aligned to the Ordnance Survey 5km national grid system (V8 has been modified to enable data to be supplied in 5km tiles and as part of a multiscale system).

Change-only updates: BGS Geology: 50k is normally released episodically as a version-controlled product. It is intended that future users will be able to check for, and incorporate 'change-only' updates to digital map data (full version-controlled updates will still be maintained).

Additional attribution: BGS Geology: 50k underpins many other digital map products. It is intended that users will be able to add additional attribute content for new themes (eg Geochemistry, Engineering). Some new content will be free, some may require additional licencing. The additional attribution can be added to the dataset via a database 'join' on a primary key (e.g. LEX-RCS or UID fields). Future attribute sets include improved provenance/reference materials, geochemical statistics and improved lithological descriptions. The Add-on datasets in Appendix 4 are examples of how additional attribution will be applied.

Inspire compliance and metadata: A dedicated metadata theme is being developed for BGS Geology: 50k; this theme will also include INSPIRE-compliant content. An additional add-on dataset will include INSPIRE-compliant descriptions of rock/deposits as well as content normally used for BGS Geology: 50k based web-map services (WMS).

BGS is undertaking a review of BGS Geology content (covering aspects of scale, completeness, structural data content and presentation, marginalia, further attribution and delivery/publication option), your thoughts and suggestions on how we can improve BGS Geology are welcomed.

Feedback

Feedback from users is always welcome.

Please report any errors/problem to digital data quoting the UUID of the feature if possible.

4 Licensing Information

The British Geological Survey does not sell its digital mapping data to external parties. Instead, BGS grants external parties a licence to use this data, subject to certain standard terms and conditions. In general, a licence fee will be payable based on the type of data, the number of users, and the duration (years) of a licence.

All recipients of a licence (potential licensees) are required to return a signed digital data licence document to us before authorisation for release of BGS digital data is given.

In general terms, a BGS digital data licensee **will** be permitted to:

- make internal use of the dataset(s)
- allow a specified number of internal users to access/use the data (the number of users will be agreed with the licensee and specified in the licence document) for the purposes of their day-to-day internal activities
- reproduce extracts from the data up to A3 for use in external analogue (paper/hard copy) or non-queryable electronic (e.g. secured .pdf) format: to meet a public task duty; fulfil a statutory requirement; and/or as part of academic or other non-commercial research

Please note: Version 8 of BGS Geology: 50k utilises an OS derived Open Data™ coastline. Users should acknowledge the source of such mapping in any extracts that are published thus: *Contains Ordnance Survey data © Crown copyright and database right [2014]*

But **will not** be permitted to:

- provide a bureau service for others or incorporate the data in the generation of products or services for commercial purposes
- sell, assign, sublicense, rent, lend or otherwise transfer (any part of) the dataset(s) or the licence
- place (any part of) the dataset(s) on the Internet

The BGS is committed to ensuring that all the digital data it holds which is released to external parties under licence has been through a robust internal approval process, to ensure that geoscientific standards and corporate quality assurance standards are maintained. This approval process is intended to ensure that all data released: (i) is quality assured; (ii) meets agreed BGS data management standards; (iii) is not in breach of any 3rd party intellectual property rights, or other contractual issues (such as confidentiality issues), that would mean that release of the data is not appropriate.

When the BGS digital datasets are revised any upgrades will be automatically supplied to the licensee, at no additional cost. Geological map datasets are revised on a periodic rather than on

an annual basis, licensees will therefore not automatically receive a new dataset each year unless changes have been made to the data.

These are general comments for guidance only. A licensee of BGS's digital data is provided with full details of the basis on which individual BGS datasets licensed to them are supplied.

If you have any doubts about whether your proposed use of the BGS data will be covered by a BGS digital licence, the BGS Intellectual Property Rights (IPR) section will be happy to discuss this with you and can be contacted through the following email address: iprdigital@bgs.ac.uk. BGS IPR will usually be able to provide reassurance that the licence will cover individual user requirements and/or to include additional 'special conditions' in the licence documentation, addressing specific requirements within BGS's permitted usage.

Appendix 1 Geological Attribution Principles

LITHOLOGY

Rocks may be described in a number of different ways. Their lithology, for example, may be defined in terms of their general characteristics of appearance: colour, texture and composition. Some lithologies may require microscope or chemical analysis for the latter to be fully determined.

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.

The igneous rocks are described in Volume 1, the metamorphic rocks are described in Volume 2 and the sedimentary rocks (and sediment) are described in Volume 3. These three volumes form the basis for the RCS codes used in the Bedrock theme in BGS Geology: 50k.

Volume 4 of the rock classification scheme, classifies man-made and natural superficial deposits according to their genesis (mode of origin) and overall form (shape) or gross composition. This volume forms the basis for identification in the Artificial, Mass Movement and Superficial themes. Note that the use of genesis and form as an identifier means that the descriptions are NOT wholly lithological.

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 comprise more than one lithology; for example, a formation of interbedded mudstone and limestone may be attributed with the composite code MDLM. Individual components in the mixed lithology are listed separately in the RCS_X field.

For the superficial deposits, the unlithified deposits are encoded to reflect the presence of six key components (clay, **C**; silt, **Z**; sand, **S**; gravel, **V**; cobbles, **L**; boulders, **B**) and peat, **P**. The codes are extended by the use of an 'X' prefix in order to include "composite" lithologies. For example, the code "VSL" describes an admixed lithology of 'cobbly, sandy gravel'; whilst the code "XVSL" describes an interbedded sequence of Gravel, Sand and Cobbles (of unknown proportions).

LITHOSTRATIGRAPHY

Many rocks are 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: Bed (lowest), Member, Formation, Subgroup, Group and Supergroup (highest). The units are usually named after a geographical locality, typically the place where exposures were first described.

Table 5 Lithostratigraphical hierarchies

<table>
<tr><th></th><th>Rank 6</th><th>Rank 5</th><th>Rank 4</th><th>Rank 3</th><th>Rank 2</th><th>Rank 1</th></tr>
<tr><td rowspan="13">Litho-stratigraphic units</td><td rowspan="3"></td><td rowspan="3"></td><td>Formation J</td><td></td><td></td><td></td></tr>
<tr><td>Formation K</td><td></td><td rowspan="5">Group C</td><td rowspan="9">Supergroup B</td></tr>
<tr><td>Formation L</td><td rowspan="2">Subgroup F</td></tr>
<tr><td rowspan="2">Bed W</td><td rowspan="3">Member U</td><td>Formation M</td></tr>
<tr><td rowspan="2">Formation N</td><td rowspan="2"></td></tr>
<tr><td>Bed X</td></tr>
<tr><td rowspan="3"></td><td>Member V</td></tr>
<tr><td rowspan="5"></td><td>Formation O</td><td rowspan="2">Subgroup G</td><td rowspan="4">Group D</td></tr>
<tr><td>Formation P</td></tr>
<tr><td>Formation R</td><td rowspan="2">Subgroup H</td></tr>
<tr><td>Formation S</td></tr>
<tr><td>Bed Z</td><td>Formation T</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>BGS Geology Fields</td><td>BED_EQ</td><td>MB_EQ</td><td>FM_EQ</td><td>SUBGP_EQ</td><td>GP_EQ</td><td>SUPGP_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 at 1:50 000 scale 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 Super-Group 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 5.

In this hierarchical scheme, each unit may have parent and child relationships with other units of greater and lesser rank respectively. For example, 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 BGS Geology fields at each of these ranks are also shown.

Lithodemic terminology

Where rocks are not laid down in stratified sequences they are given names using a lithodemic scheme, as shown in Table 6. 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 (the same number as in the lithostratigraphic scheme, although there is not necessarily any direct correlation 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. (see Table 6 below). These can be applied to igneous intrusive, highly deformed and/or highly metamorphosed and genetically mixed assemblages of rocks.

Table 6 Lithodemic hierarchies

	Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1
intrusive units	intrusion	pluton	centre cluster	subsuite	suite	supersuite
		ring-intrusion				
		lopolith				
		intrusion-swarm				
	laccolith	laccolith-swarm				
	plug	plug-swarm				
	vent	vent-swarm				
	pipe	pipe-swarm				
	neck	neck-swarm				
	diatreme	diatreme-swarm				
	sheet	sheet-swarm				
	dyke	dyke-swarm				
	sill	sill-swarm				
	ring-dyke	ring-swarm				
	cone-sheet	cone-sheet-swarm				
	vein	vein-swarm				
tectono-metamorphic units	lens, block	train, swarm	set	sub-assemblage	assemblage	super-assemblage
	layer, mass	unit	package	sub-succession	succession	super-succession
mixed class units			sheet-complex sill-complex vein-complex ring-complex	subcomplex ophiolite-complex central complex volcano-complex	complex	super complex
BGS Geology fields	**BED_EQ_D**	**MB_EQ_D**	**FM_EQ_D**	**SUBGP_EQ_D**	**GP_EQ_D**	**SUPGP_EQ_D**

A similar scheme 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 BGS Geology 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.

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 methods are 'absolute' and typically measure time units in millions of years

(before present). Chronostratigraphy, 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 7, in which the principal ranks range from stage (small subdivisions) to eonothem (large subdivisions).

Table 7 Chronostratigraphical and geochronological hierarchies

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

Geochronology, as used in BGS Geology: 50k, deals with 'time' units and refers directly to the time spans. The corresponding principal formal geochronological terms range from Age to Eon. The same name can be used in both schemes; thus rocks of the Jurassic "*System*" were deposited during the Jurassic "*Period*" of time.

The BGS timechart (http://www.bgs.ac.uk/discoveringGeology/time/timechart/home.html) and the latest version of the ICS time chart (http://www.stratigraphy.org/index.php/ics-chart-timescale) can be used to discover further information about chronostratigraphy and Geochronology.

STRUCTURE

Faults

Geological faults are the most common feature in the Linear theme of the BGS Geology data but uncertainties often affect their mapped position at the surface (or at 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 along the surface of the fault.

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

A fault is typically portrayed in BGS Geology: 50k as a single line. Therefore, users should be aware that this linear representation does not imply any specific dimensions or characteristics to the fault/fault zone, the line merely represent the apparent location of a faulted-feature.

Faulting in BGS Geology: 50k has been extracted from previously published paper maps or 3d modelling work. Evidence for the existence of faulting can be based upon ***observed*** exposures (above and below ground) or by inference linear depressions, the truncation or displacement of topographical features, or the sudden change in geology proved by boreholes (i.e the fault is ***inferred***). If there are superficial deposits at surface then the position, nature and maybe even the existence of a fault recorded within the underlying bedrock will be ***conjectural***.

Faulting is a response to structural evolution of the landscape, and faulting can be more common in some areas than others. However, because faults are easier to identify and map in areas with large amounts of supporting evidence, some parts of Great Britain appear to be more faulted than others. Users should be aware that BGS Geology: 50k faults are a representation of survey evidence and inference and may not represent the complete distribution of faults in an area.

Traditionally, on paper maps, where one side of a normal fault is downthrown relative to the other, the downthrown side is indicated by a small ‘tick’ on the fault line (representing the ‘hanging wall’ side). Similarly for thrust faults the up thrown side is marked with a triangle (again this is the hanging wall of the fault).

It has not been possible to provide a consistent digital representation of faults and their hanging wall orientation due to processing and conversion to other formats. BGS is currently redeveloping its fault database to provide more robust orientation attribution in future versions. In the latest BGS Geology: 50k data (V8), a new attribute has been added to the linear theme that provides a compass rose indicator of which side of a fault represents the hanging wall. This new field is calculated by comparison of geological ages of materials either side of the fault, and is **being trialled** for a subset of the faults to see if the data can remain consistent in the normal processes of publication and translation that can occur in digital files. **Information on fault throw (hanging wall) remains incomplete and subject to change in BGS Geology: 50k**. Users are advised to use the hanging wall indicators with caution, and seek further advice from BGS where necessary.

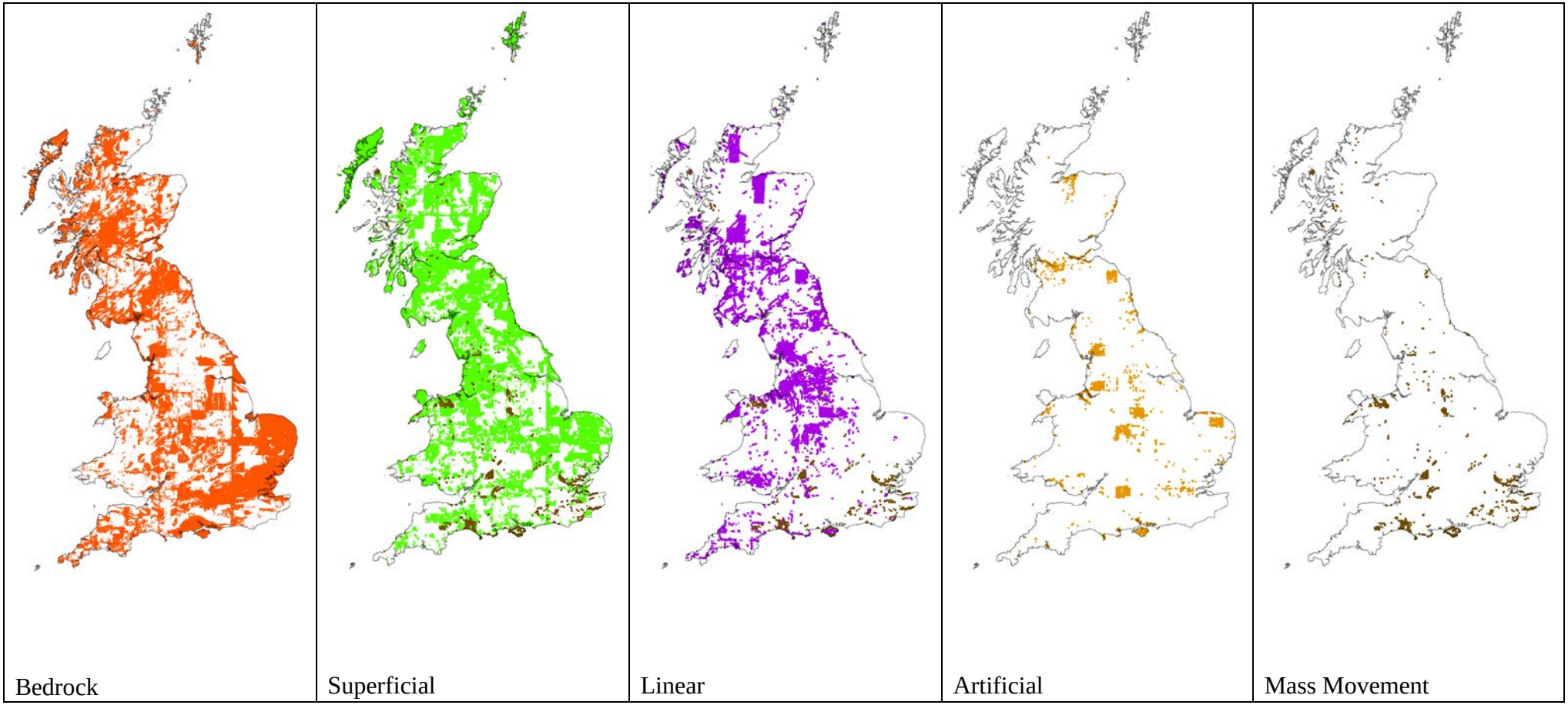
Folds

Many of the rocks forming the earth’s crust have been deformed by structural evolution 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 Earth’s surface may be shown in BGS Geology: 50k depending upon on the scale of the fold feature (e.g. micro folds may not be shown at the 1:50 000 scale).

As for fault-related features, evidence for fold axes is based on observation or inference. Some uncertainty therefore attaches to their mapped position; their linear representation in the data should be regarded as zones of folding.

Appendix 2 Changes in Spatial Data in Version 8

Locations of new or modified content in Version8 (by comparison with V7)

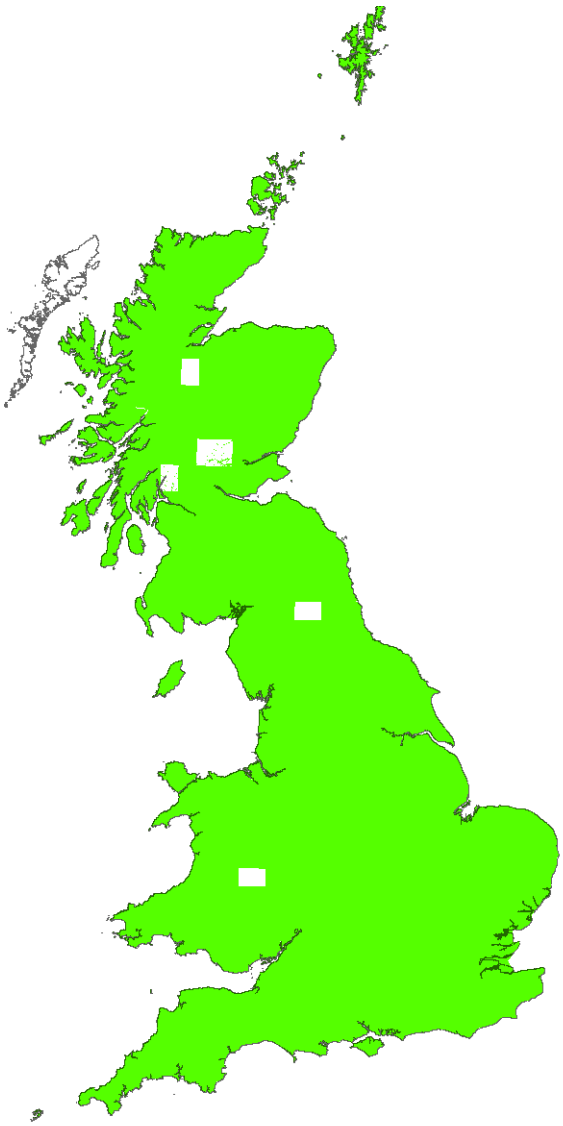


Bedrock | Superficial | Linear | Artificial | Mass Movement

Appendix 3 Coverage of Spatial Data in Version 8

Coverage of 1:50 000 scale data in BGS Geology: 50k Version 8,

Bedrock coverage at 1:50k



Superficial coverage at 1:50k

Appendix 4 Appending additional data to BGS Geology: 50k

This section provides guidance on ‘add on’ datasets to the BGS Geology: 50k product.

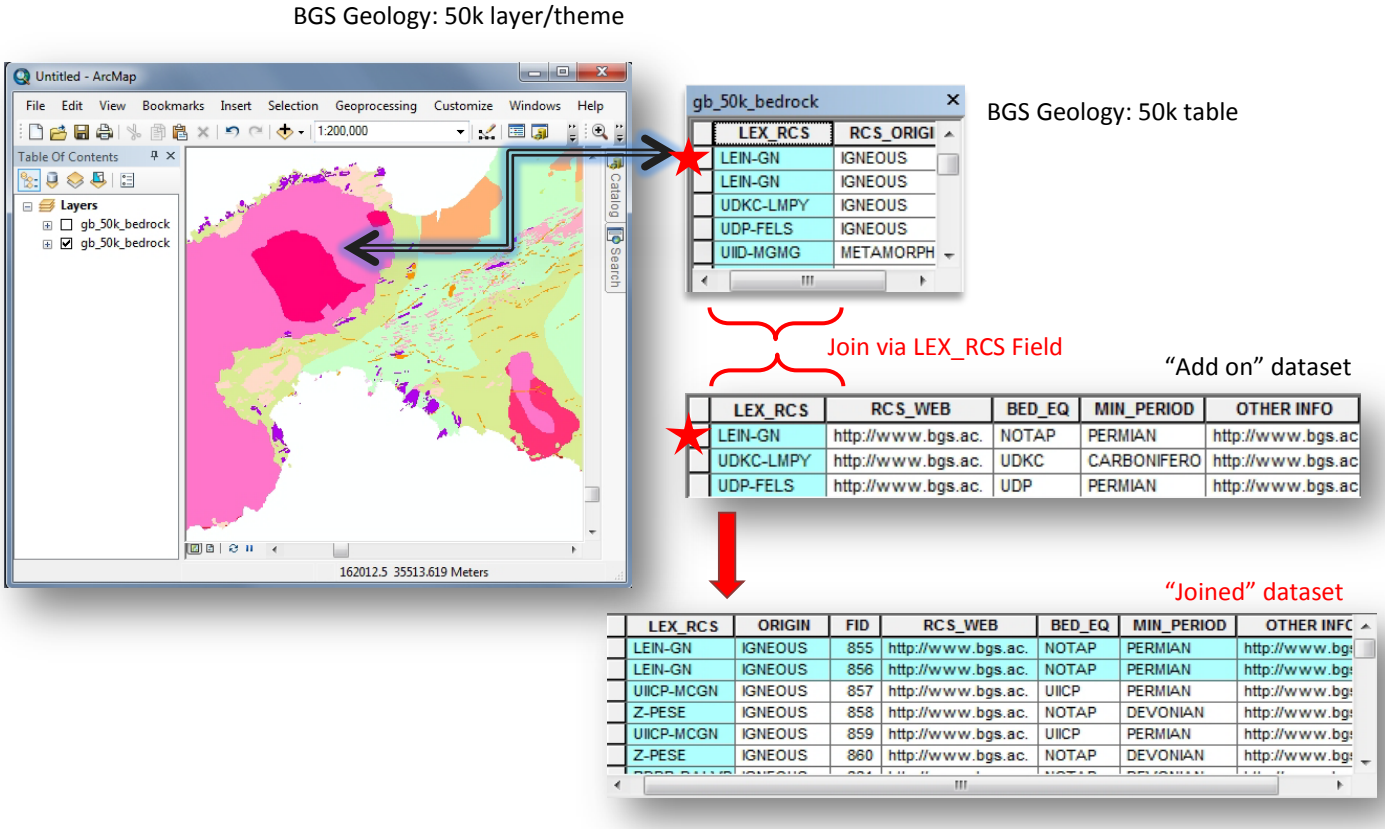
An ‘add on’ dataset is a set of additional attributes that are applicable to the BGS Geology: 50k spatial data. They can be appended by using a database ‘join’ (a way of linking data) to extend the range or detail of the information available. They are sometimes called ‘look-up tables’, and are useful, because they are a compact way of storing data that is normally repeated many times within a dataset, or storing data that is used rarely, or only needed by a few users.

For BGS Geology: 50k there are currently two add-on datasets:

1. Deprecated information (attribution previously supplied in V7 or earlier)
2. Colour tables (RGB triplets for automated colour coding of maps)

BGS intends to supply additional add-on data for EU-Inspire compliance and emulation of other BGS Geology variants (e.g. replicating the web version of BGS Geology: 50k).

Add on datasets are supplied in ascii CSV format (comma-separated values). Most GIS software offers a function to ‘join’ data (or ‘relate’ data) onto a digital map. These add on datasets are designed to be joined by ‘attribute’, using a ‘primary key’. A primary key is simply a field within the datasets that identifies each record in a unique way. For BGS Geology: 50k we typically use the LEX_RCS field as our primary key. The images below outline the basic principle behind the data join:



Joining data for common GIS software is also described at the following resources:

(QGIS) http://www.qgistutorials.com/en/docs/performing_table_joins.html

(ESRI) http://desktop.arcgis.com/en/arcmap/10.3/manage-data/tables/essentials-of-joining-tables.htm

(MapInfo) http://www.pbinsight.com/support/education/video-tutorials/detail/joining-tables/

The two add on packs provided with BGS Geology: 50k are called:

- Deprecated_data.csv and
- BGS_colours.csv

They are described below in tables 8 and 9, and both can be joined to any theme/layer in BGS Geology: 50k that contains a LEX_RCS field.

Table 8 Fields available in the BGS Geology: 50k Deprecated attributes pack

DATA FIELD	EXPLANATION OF DATA FIELD	Note
LEX_RCS	The primary key. This field is used to join the other field in this table onto the map data in BGS Geology: 50k	
BGSTYPE	The BGS Geology theme for which the added data is relevant: e.g. BEDROCK, SUPERFICIAL	
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	a
BED_EQ	Bed or equivalent. Lexicon code for the unit at bed or equivalent level where applicable	b
MB_EQ	Member or equivalent. Lexicon code for the unit at member or equivalent level where applicable	
FM_EQ	Formation or equivalent. Lexicon code for the unit at formation or equivalent level where applicable	
SUBGP_EQ	Subgroup or equivalent. Lexicon code for the unit at subgroup or equivalent level where applicable	
GP_EQ	Group or equivalent. Lexicon code for the unit at group or equivalent level where applicable	
SUPGP_EQ	Supergroup or equivalent. Lexicon code for the unit at supergroup or equivalent level where applicable	
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	c
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	
MIN_AGE	Minimum age. Name of the age of minimum geochronological time applicable: e.g. ALPORTIAN	d
MIN_ EPOCH	Minimum epoch. Name of the epoch of minimum geochronological time applicable: e.g. NAMURIAN	
MIN_SUBPER	Minimum sub-period. Name of the sub-period of minimum geochronological time applicable: e.g. PENNSYLVANIAN	
MIN_ PERIOD	Minimum period. Name of the period of minimum geochronological time applicable: e.g. PERMIAN	
MIN_ERA	Minimum era. Name of the era of minimum geochronological time applicable: e.g. MESOZOIC	
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	b
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)	e
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	

Note a: The RCS code is a multi-use code (single, composite and concatenated codes), unfortunately the web link is only able to interpret the single-code variant and can fail when used against the other types. BGS has decided to drop the use of the RCS hotlink in favour of the manual search available: http://www.bgs.ac.uk/bgsrcs/home.html

Note b: BGS Geology: 50k V8 provides the 'descriptions' to these lithostratigraphic 'codes' and previous names. User feedback has indicated that the codes are infrequently used (compared with the description). These codes are all readily available (and maintained as a live, updated service) via the LEX_WEB hyperlink. The web link is a preferred mechanism for finding 'previous names' because the changes in UK stratigraphy names/concepts can be locally complex, requiring the wider resources available online.

Note c: The Indexing fields are a mechanism to assist in developing semi stratigraphically sorted map legends. This facility is already provided by the LEX_RCS_I field.

Note d: The geochronological names for each record are provided by the LEX_WEB hyperlink

Note: The BGSREF colouration system is being phased out and replaced with RGB triplets (see colour 'add on' file). User feedback indicates that these variants are infrequently used.

Table 9 Fields available in the BGS Geology: 50k colour attributes pack

DATA FIELD	EXPLANATION OF DATA FIELD
LEX_RCS	The primary key. This field is used to join the other field in this table onto the map data in BGS Geology: 50k
BGSRED	RGB triplet (red) colour code used to define the foreground colour of the object (0 – 255)
BGSGREEN	RGB triplet (green) colour code used to define the foreground colour of the object (0 _ 255)
BGSBLUE	RGB triplet (blue) colour code used to define the foreground colour of the object (0 - 255)
BGSRGB	RGB integer colour code used to define the foreground colour of the object (0 - 16777215)