BGS Informatics

User guide: BGS Geology 10k-25k v3

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British Geological Survey

BRITISH GEOLOGICAL SURVEY

INFORMATICS PROGRAMME

OPEN REPORT OR/24/042

User guide: BGS Geology 10k-25k v3

British Geological Survey

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Front cover

Folded veins of granite cutting Leven Schist, River Roy, Scotland, Source BGS Geoscenic P008654.

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Keyworth, Nottingham British Geological Survey 2025

BRITISH GEOLOGICAL SURVEY

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The London Information Office also maintains a reference collection of BGS publications, including maps, for consultation.

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 UK Research and Innovation.

British Geological Survey offices

Nicker Hill, Keyworth,
Nottingham NG12 5GG

Tel 0115 936 3100

BGS Central Enquiries Desk

Tel 0115 936 3143
email enquiries@bgs.ac.uk

BGS Sales

Tel 0115 936 3241
email sales@bgs.ac.uk

The Lyell Centre, Research Avenue South,
Edinburgh EH14 4AP

Tel 0131 667 1000
email scotsales@bgs.ac.uk

Natural History Museum, Cromwell Road,
London SW7 5BD

Tel 020 7589 4090
Tel 020 7942 5344/45
email bgslondon@bgs.ac.uk

Cardiff University, Main Building, Park Place,
Cardiff CF10 3AT

Tel 029 2167 4280

Maclean Building, Crowmarsh Gifford,
Wallingford OX10 8BB

Tel 01491 838800

Geological Survey of Northern Ireland, Department of Enterprise, Trade & Investment, Dundonald House, Upper Newtownards Road, Ballymiscaw,
Belfast, BT4 3SB

Tel 01232 666595
www.bgs.ac.uk/gsni/

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU

Tel 01793 411500   Fax 01793 411501
www.nerc.ac.uk

UK Research and Innovation, Polaris House,
Swindon SN2 1FL

Tel 01793 444000
www.ukri.org

Website www.bgs.ac.uk
Shop online at www.geologyshop.com

Foreword

The British Geological Survey (BGS) is a world-leading geological survey, focusing on public-good science for government, and research to understand earth and environmental processes.

We are the UK's premier provider of objective and authoritative geoscientific data, information and knowledge to help society to:

- use its natural resources responsibly
- manage environmental change
- be resilient to environmental hazards

We provide expert services and impartial advice in all areas of geoscience. As a public sector organisation, we are responsible for advising the UK Government on all aspects of geoscience as well as providing impartial geological advice to industry, academia and the public. Our client base is drawn from the public and private sectors both in the UK and internationally.

The BGS is a component body of the Natural Environment Research Council (NERC), part of UK Research and Innovation (UKRI).

DATA PRODUCTS

The BGS produces a wide range of data products that align to government policy and stakeholder needs. These include baseline geological data, engineering properties and geohazards datasets. These products are developed using in-house scientific and digital expertise and are based on the outputs of our research programmes and substantial national data holdings.

Our products are supported by stakeholder focus groups, identification of gaps in current knowledge and policy assessments. They help to improve understanding and communication of the impact of geo-environmental properties and hazards in Great Britain, thereby improving society's resilience and enabling people, businesses, and the government to make better-informed decisions.

Acknowledgements

This report is the published product of a study by the British Geological Survey (BGS) to produce a digital dataset depicting the geology of Great Britain. This user guide is written by R. Lawley with editorial input from K. Linley, D. Daley and H. Burke.

The author would like to thank the many individuals (past and present) in BGS including geologists; cartographers and Geographic Information System (GIS) experts who have helped create, maintain and update the BGS Geology 10k-25k v3 dataset.

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BGS Geology 10k-25k v3 (formerly known as DiGMapGB -10) is the most detailed geological dataset produced by the British Geological Survey (BGS) and is based on our highest-resolution survey mapping. It is provided at 1:10 000 scale but contains a small proportion of 1:25 000 scale data in some upland areas (which was previously published as DiGMapGB-25).

These digital geological maps are based on our previously published paper maps. BGS Geology 10k-25k v3 has an incomplete coverage but does include many urban centres and transport routes in Great Britain making it of potential use to a wide range of customers. Work is ongoing to digitise and publish our remaining paper map archive and ongoing survey programme.

The maps are attributed with descriptions relating to geological age (lithostratigraphy), mode of emplacement (lithodemic origin), and composition (rock type or lithology). This information is arranged into five components that make up a typical geological map (as available): bedrock geology; superficial deposits; mass movement deposits, artificial ground, and linear features.

The information provided in this User Guide is intended to give an overview to using and understanding this BGS Geology 10k-25k v3 data product.

1 Introduction

The BGS Geology 10k-25k v3 dataset is a digital representation of the most recently published geological maps at 1:10 000 scale (or 1:10 560 scale for areas surveyed prior to 1970), and 1:25 000 scale (in upland areas). It comprises 5069 map tiles (based on the Ordnance Survey 1:10 000 scale 'quarter sheets'), covering approximately 109,000 km^2 (c.52%) of Great Britain. The digital dataset has been developed over several years (since 2003) and is the result of a series of high-resolution mapping activities at BGS, including:

- Original survey
- Compilation & original publication
- Digital capture & re-publication

This guide relates to Version 3.25 formally released in 2024 (BGS, 2024). Each version release has included new and replacement content that reflects the ongoing work of the BGS to extend and improve its geological map coverage. What the data show

The BGS Geology 10k-25k v3 data are a digital map representation of the geology of Great Britain. The data are the highest resolution mapping available from BGS. However, it is an incomplete coverage, representing approximately 50% of the country (see Figure 2); work continues to extend the geographical cover via further capture of our paper map archive, and ongoing modern surveys.

The data are arranged into four geological themes:

1. **Bedrock geology**: the main mass of rocks forming the Earth, and which are present everywhere, whether exposed at the surface in rocky outcrops or concealed beneath superficial deposits, artificial ground, soil, or water.
2. **Superficial deposits**: the youngest geological deposits formed during the most recent period of geological time, the Quaternary. They date from about 2.58 million years ago to the present.
3. **Mass movement deposits**: primarily superficial deposits or weathered bedrock that have moved downslope under gravity to form landslips.
4. **Artificial ground**: where the ground surface has been significantly modified by human activity including quarrying, landscaping, land-raise, cuttings, and embankments.

And one additional map component:

Linear features: an intrinsic part of the bedrock and superficial themes defining relationships between geological units or landscape features. Linear features are useful additional data that can help you understand the structure and origin of the geological map.

Each theme is provided as an individual layer of data for viewing within a GIS. The bedrock, superficial, mass movement and artificial layers represent geological units as a series of polygons with full attribution. The linear features layer consists of a series of polylines with attribution; it 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, with each field of attribution specific to the layer and the characteristic of the feature being described. Attribution may include information such as the age of a geological unit, its lithology (see Appendix 1), links to further resources (such as hyperlinks to BGS webpages) and 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 10k-25k v3 is provided in the attribute descriptions section 4.3 below.

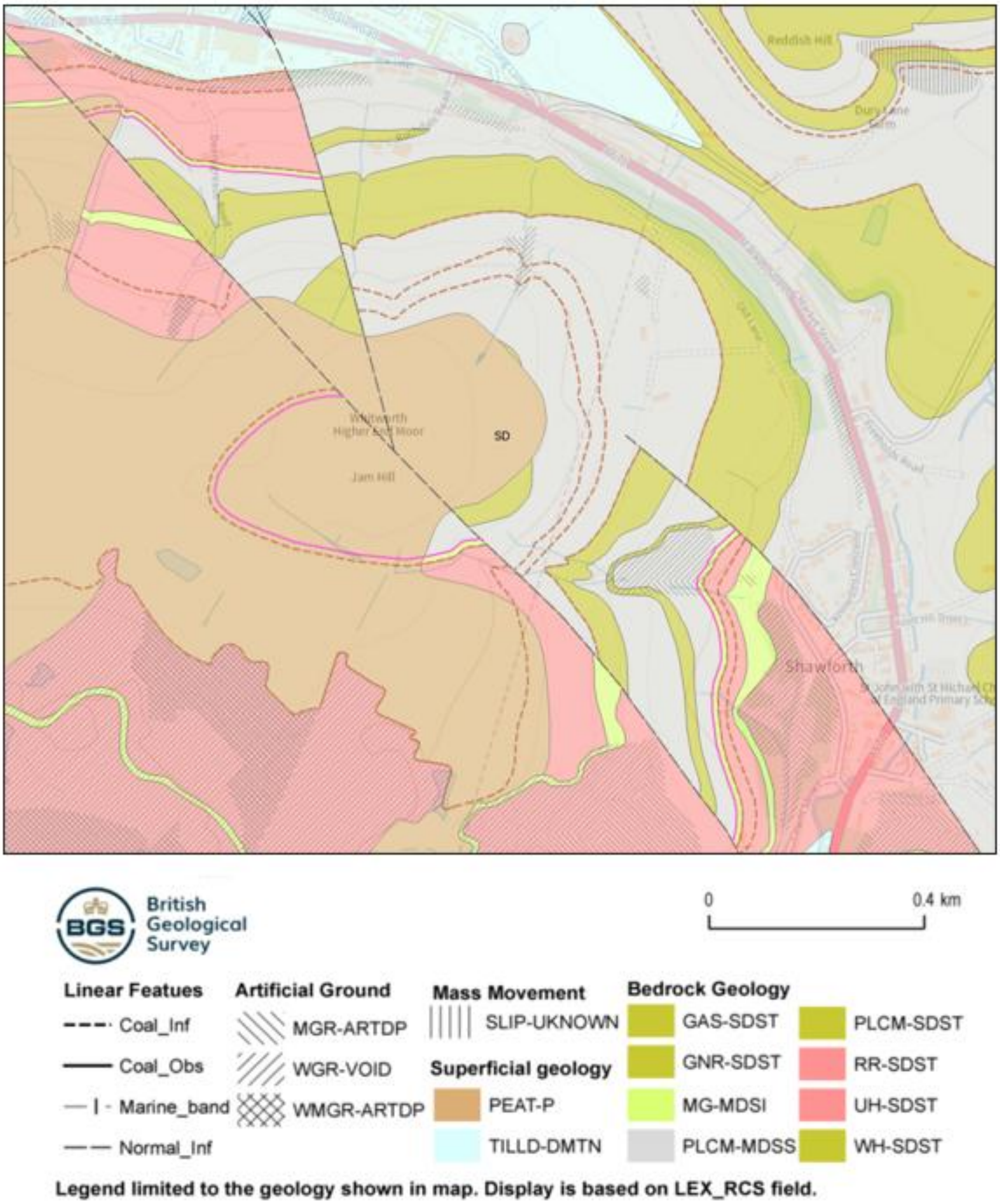

Figure 1 Example of BGS Geology 10k-25k v3. Topographic backdrop: Contains OS data © Crown copyright and database rights 2024. OS AC0000824781 EUL

1.1 WHO MIGHT REQUIRE THIS DATA

Geological maps are the foundation for many types of environmental work. Potential uses differ according to map scale, ranging from detailed site-level study (typically 1:10 000 scale), through local and regional generalisations (1:50 000 to 1:250 000 scale), to national overviews (1:625 000).

Digital maps are of 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 and landscape development.

The BGS Geology 10k-25k v3 dataset offers users information at a site-development scale, but should not be used instead of a detailed site investigation.

This dataset is of particular relevance to any user requiring a high degree of geological detail for a specific area (e.g., across a local area of 1 or 2 Km^2). The dataset is typically consulted by experts about to embark on a site redevelopment for construction or mineral resource purposes.

The data are commonly used to provide information for Environmental Impact Assessments, outline planning applications, and desktop studies of site design, reviews of natural capital, land-use, natural hazards, and redevelopment.

2 Case Study

The BGS Geology 10k-25k v3 dataset offers users a site development scale geological product (but should not be relied upon for site-specific information). The dataset's high resolution lends itself to analysis of localised scale, it is widely used by many stakeholders to provide baseline information about ground conditions for their areas of interest.

The dataset is for example designed to assist users who may need to find evidence for environmental policy or regulation when developing a new site or 'breaking ground' on a construction project.

2.1 THE PROBLEM

A housing development requires suitable land with supporting evidence of ground conditions to meet planning and environmental regulations (specifically an environmental impact assessment). Engineers have identified some potential sites, but they now need to assess whether there are any ground conditions that may impact upon design and construction of the dwellings, and whether there are any issues to be considered prior to further site investigation.

2.2 THE CHALLENGE

The challenge is to identify ground conditions and processes that may influence the scope or impact of the development. The first task is to draw up a shortlist of potential sites and establish basic geological conditions for construction at each location that may influence the development layout or foundation-designs for building and other infrastructure. The second task is to ensure that the development(s) are screened against a range of environmental metrics (to fully document the impact assessment). A further challenge may be to identify potential resources proximal to the sites to reduce transport costs of raw materials (and ensure that sites do not sterilize future buried resources).

The engineers are looking for the best compromise in site conditions, with minimised impact on the local environ, and with options for potential localised resourcing. If working in an urban or peri-urban setting, this may include utilising brownfield sites, which will require further analyses to determine their suitability for development and potential sub-soil hazards.

2.3 THE SOLUTION

The BGS Geology 10k-25k v3 dataset has a suitable combination of resolution (+/- 10 to +/- 25m) and lithological detail, with coverage focused on urban centres. It can be used to identify basic geological facts for each development prospect, as well as identifying specific perils such as faulting, landslides, or anthropogenic materials.

For meeting specific types of planning or construction regulation, the geology information can be further enhanced with additional data (e.g., borehole data, or civil engineering and geochemical data). Once the preferred development site is populated with geology data, engineers can quickly analyse the evidence to see what further information is needed to measure ground conditions (e.g., if a particular type of geological unit at foundation level requires handling or treatment in a specific way). Once a detailed outline of key engineering metrics is established, the development can be designed around avoidance of perils and sustainable use of materials.

The BGS Geology 10k-25k v3 dataset can also be readily used to identify local resources such as sand and gravel, or used in conjunction with the BGS Mineral Resources Maps to determine if any proposed sites may cause resource sterilization. This will help ensure that mineral planning requirements are met, as well as assisting in the completion of the environmental impact assessment.

BGS Geology 10k-25k v3 can used in conjunction with BGS Civils (engineering properties: bulking volume, corrosivity ferrous, discontinuities, engineered fill, excavatability, foundation conditions, strength, sulfate/sulfide); BGS GeoSure (compressible ground, collapsible ground, landslides, soluble rocks (dissolution), running sand, shrink swell), and the BGS/PHE Radon datasets to determine ground conditions for many site investigations. It is applicable to greenspace and brownfield developments and has a range of uses for determining land-use history as well as land-use potential.

3 Methodology

The BGS Geology 10k-25k dataset is a digital representation of the most recently published geological maps at 1:10 000 and 1:25 000 scale (or 1:10560 scale for areas surveyed and published prior to 1970). It comprises the equivalent of 5069 OS 10k map sheets.

3.1 ORIGINAL SURVEY

Geology mapping is an interpretation of what was observed and inferred at the time of survey. For many parts of Great Britain, geological units are obscured by infrastructure, vegetation, soil or water. Unlike other types of survey where features are often readily visible and measurable to a surveyor; it is not always possible to directly observe geology everywhere across the landscape.

BGS surveyors use a range of techniques to interpret geological characteristics from rock exposures, and other indirect sources, such as boreholes, geochemistry, and geophysics to then extrapolate the likely geometries of the geological units across areas with no exposure.

Field surveys were traditionally captured on ‘field-slips’ (annotated topographic maps) and notebooks; BGS has been surveying at 1:10 000 scale since 1970 (following the introduction of the standardised 1:10 000 base map from the Ordnance Survey). Previously, BGS surveyors utilised 1:10 560 base mapping (‘county’ series mapping). For some rural areas, BGS surveyors have utilised 1:25 000 base mapping from Ordnance Survey.

Modern geological surveys utilise a range of digital systems to record ‘traditional’ human-surveyed information as well as autonomous and sensor-surveyed data streams. Survey techniques are adapted to suit the terrain being surveyed.

A survey of Quaternary deposits will require different types and quantities of evidence, compared with that required for an area of Carboniferous strata. Similarly, legacy surveys will have been designed to resolve specific challenges at that time. For example, a survey from 1920, will have had a focus on resource mapping, whilst a modern survey in 2020 is more likely to focus on environmental factors and processes. As a result of the wide range of survey parameters, BGS maintains an extensive paper and digital archive of previous survey data.

3.2 COMPILATION & ORIGINAL PUBLICATION

Following a survey, BGS geologists compile their field mapping evidence and any desktop-modelled information, into a ‘clean-copy’ map, showing the whole, final geological understanding of the map tile.

Batches of ‘clean copy’ tiles are further reviewed to ensure that the geological understanding is consistent across a wider survey area, before being passed to the cartography team.

Modern surveys compile the digital datasets into a ‘desktop model’ of geology which is then ingested into the main BGS Geology 10k-25k v3 database.

3.3 DIGITAL CAPTURE & RE-PUBLICATION

As part of wider digital capture programme, the geological standards held in paper and plastic map archives have been digitised into the five thematic GIS layers described in section 0. These data are incorporated into the main BGS Geology 10k-25k v3 database which holds all the recent survey work captured in the ‘all digital’ environment.

In addition to capturing the map information as spatial objects, each object is attributed with a range of feature-specific textual information (e.g., age, lithology) as well as basic metadata about each survey tile and unique object identifiers.

3.4 COMPARING DIGITAL AND PAPER MAPS

It is common for BGS Geology 10k-25k v3 content to differ from the information shown on many of the original paper maps. During compilation, the digital data is modified to improve nomenclature (to current usage/terminologies), identified errors on printed maps will be periodically corrected and, in some cases, additional or revised geological interpretations (derived from information gathered since the last survey) may have been created. The BGS Geology 10k-25k v3 dataset should be regarded as a dynamic document, subject to continuous update and correction.

Unlike traditional paper maps, BGS Geology 10k-25k v3 is supplied without topographic backdrop, cartographic symbology, cartographic legends, generalised vertical sections, or other marginalia. It is designed to provide a simple geological backdrop for users to review within digital mapping software. Users are advised to exercise caution if comparing analogue and digital sources of mapping data and to seek further guidance from BGS if they require further clarification.

4 Technical Information

4.1 SCALE

The BGS Geology 10k-25k v3 data are intended for use at 1:10 000 scale (with some rural areas limited to 1:25 000 scale). As such the underlying geological linework is considered accurate to +/- 10m (in areas of 10k data) and +/- 25m (in areas of 25k data).

4.2 COVERAGE

BGS Geology 10k-25k v3 has incomplete coverage of Great Britain (see Figure 2). The dataset comprises 5069 map tiles (and partial tiles), based on the Ordnance Survey 1:10 000 scale map sheets, and covers approximately 109,000 km^2 (circa 52%) of Great Britain.

BGS continues to update the mapping at this scale to extend the geographical cover to include large urban areas and transport corridors. Where there is no cover for a theme at 1:10 000 scale, the smaller scale 1:50 000, 1:250 000 or 1:625 000 data are available.

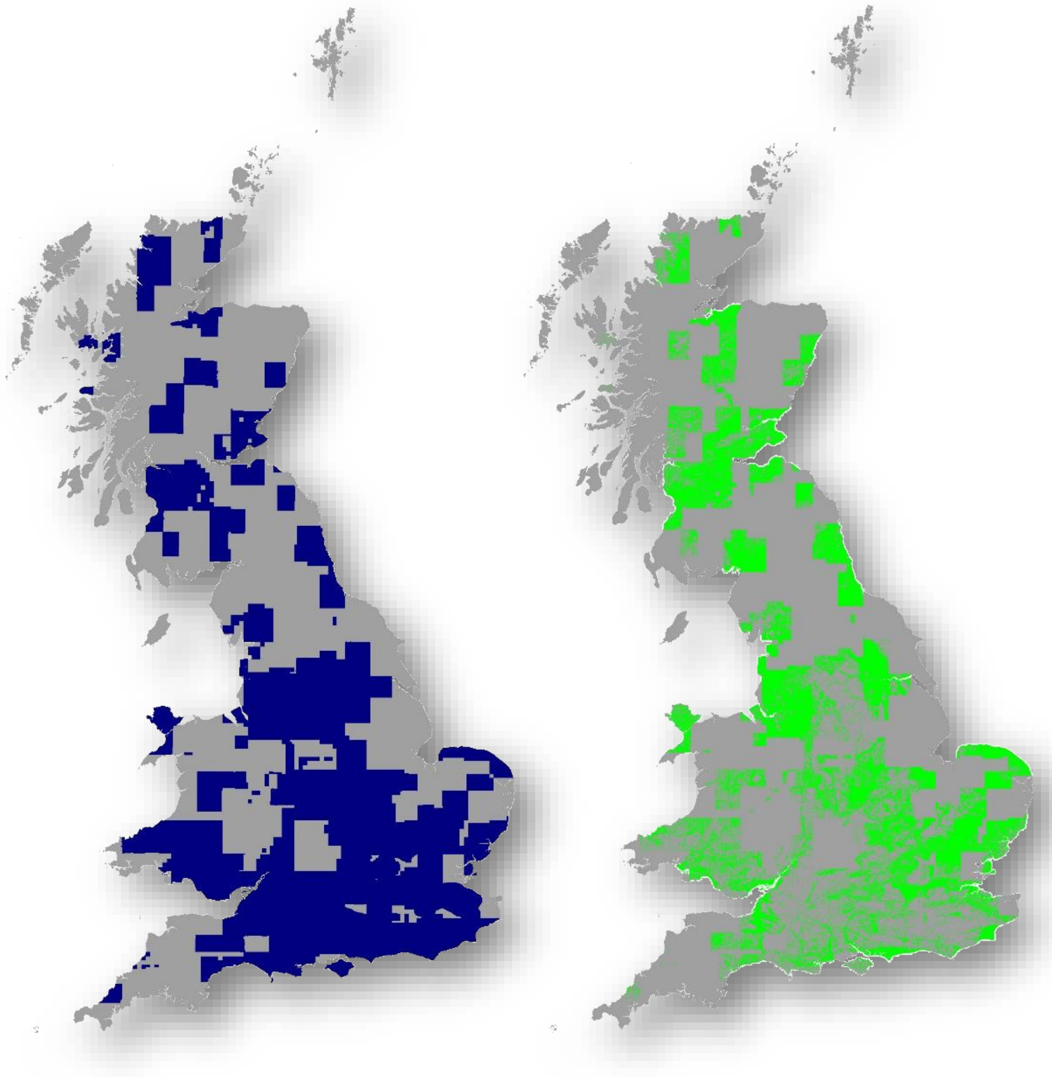

Figure 2 BGS Geology 10k-25k v3 coverage (Bedrock shown in blue, Superficial deposits shown in green, unmapped areas shown in grey). Coastline: Contains OS data © Crown copyright and database right 2024

4.3 ATTRIBUTE DESCRIPTION

Each geological theme (map layer) in BGS Geology 10k-25k v3 contains a series of attribute fields. Attribution is specific to the theme, for example, bedrock objects are attributed with lithostratigraphic, chronostratigraphic or lithodemic class (see Appendix 1), whereas the linear theme with features such as geological faults includes additional classifications. Table 1 and Table 2 describe the attributes in each layer.

BGS aims to provide a balance between built-in content and web-delivered content, alongside potential for 'add-on' information/dictionaries from other resources. Each layer may therefore contain hyperlinks to online content provided by BGS.

4.3.1 Attribution fields for the Artificial, Mass-movement, Bedrock and Superficial themes

The Artificial, Mass-movement, Bedrock and Superficial themes depict domains 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 the polygons in these four themes are described in Table 1.

Table 1 Attribution of Artificial, Mass-movement, Bedrock and Superficial themes

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*
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.	

BGSRED	The RGB colour value for Red (expressed as a value between 0 and 255), for the LEX_RCS attribute (as seen in the provided style sheets)
BGSGREEN	The RGB colour value for Green (expressed as a value between 0 and 255), for the LEX_RCS attribute (as seen in the provided style sheets)
BGSBLUE	The RGB colour value for Blue (expressed as a value between 0 and 255), for the LEX_RCS attribute (as seen in the provided style sheets)
SHEET	Name of the digital geological tile (based on the Ordnance Survey 5km tile identifier): e.g., TQ38SW
VERSION	Version number and attribute level of the digital data: e.g., 3.25 is version 3, with attribute level 25
RELEASED	Date the BGS Geology data files were created by BGS: e.g., 31-03-2025
NOM_SCALE	Nominal scale of the published (or compiled) information used to prepare the digital data e.g., 10000 for 1:10 000 [including 1:10 560] and 25000 for 1:25 000 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 'not entered'
UUID	Universally Unique Identification that can be used to identify individual features: e.g., bgsn:BGSGeology10_25_V3_20080728114004453
GUID	Globally Unique Identification that will be used to identify individual features in future BGS services: e.g., 4e526e5d-58c3-420b-84ba-31d9fd4163c5

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 3, this is in part to assist users who wanted to know some fundamental properties of the geological materials (see future revisions section).*
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 e.g., 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 lithostratigraphic 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 v3 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 Time chart available at: https://www.bgs.ac.uk/discovering-geology/fossils-and-geological-time/geological-timechart/ (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 Time chart. '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 v3 are correct at time of publication.*

1.1.1 Attribution fields for the linear theme

BGS Geology 10k-25k v3 includes a linear layer to portray geological features and concepts that are normally depicted on maps in linear form. This layer includes:

- FAULTS (Lines representing planes of structural movement such as: normal faulting or thrusts. Relevant to the Bedrock theme (see Appendix 1.2.1).
- MINERAL_VEINS (Lines representing the surface expression of mineralised fractures/veins. Relevant to the Bedrock theme).
- FOLD_AXES (Lines representing planes of structural change/symmetry such as: anticline or syncline. Relevant to the Bedrock theme).
- ALTERATION_AREAS (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).
- LANDFORMS (Lines that represent landform features e.g., dune crest-line or channel margins Relevant to all themes and topography).

The Linear layer is attributed in a similar manner to the polygonal layers, as described in Table 1 but includes additional fields for linear-specific details described in Table 2.

Table 2 Additional attribution fields of the linear layer

DATA FIELD	EXPLANATION OF DATA FIELD
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
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

4.4 DATA FORMAT

The BGS Geology 10k-25k v3 data are created in vector format. They are routinely released in ESRI® shapefile format. Other vector formats are available on request. More specialised formats may be available but may incur additional processing costs. Please email BGS Enquiries (enquiries@bgs.ac.uk) to request further information.

4.5 DATASET HISTORY

The data was previously published as:

- DiGMapGB-10 V1.11 in 2008 (comprising 1300 tiles)
- DiGMapGB-25 V2.18 in 2013 (comprising 543 tiles)
- DiGMapGB-10 V2.18 in 2013 (comprising 3299 tiles)

4.6 DISPLAYING THE DATA

It is recommended that the five layers of data within BGS Geology 10k-25k v3 are displayed in the following order within GIS (to allow best visualisation and clarity of the map objects):

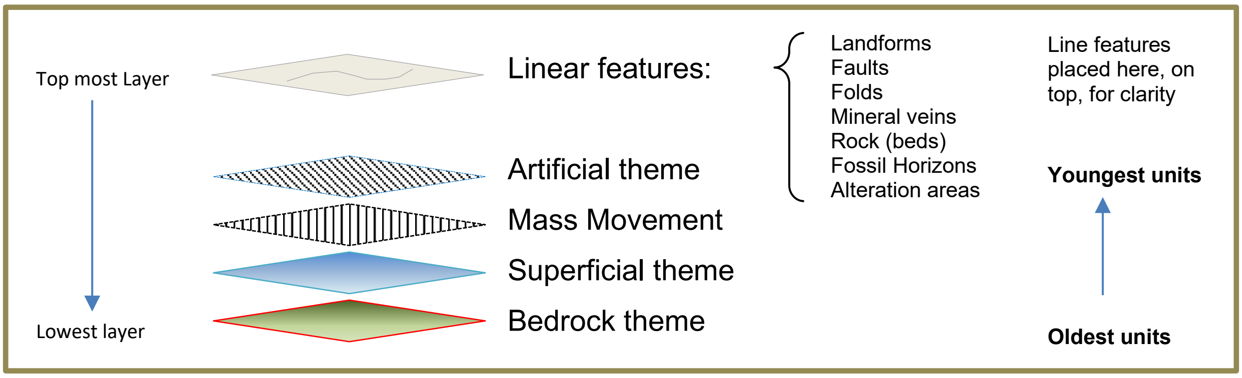

Figure 3 Recommended layer ordering.

Users should be aware that some themes are intrinsically related to each other, for example, the 'Fault' features from the linear theme are directly relevant to the bedrock theme; and the mass-movement theme should always be assessed in conjunction with the superficial and bedrock themes example shown in Figure 1.

4.6.1 Map colours

BGS Geology 10k-25k v3 replicates the printed colours used on paper maps as far as possible. The dataset is supplied with styling options relevant to ESRI, MapInfo and QGIS platforms in the form of styling sheets.

In addition to style sheets, there are additional colour codes embedded within the data for each map object as indicated in Table 3 below. These allow users to thematically re-style the map content.

Table 3 Colour coding fields

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)
BGSRED	The RGB colour value for Red (expressed as a value between 0 and 255), for the LEX_RCS attribute (as seen in the provided style sheets)
BGSGREEN	The RGB colour value for Green (expressed as a value between 0 and 255), for the LEX_RCS attribute (as seen in the provided style sheets)
BGSBLUE	The RGB colour value for Blue (expressed as a value between 0 and 255), for the LEX_RCS attribute (as seen in the provided style sheets)

The colour code takes the form of a numerical value. The BGSRED, BGSGREEN and BGSBLUE fields can be used directly in any GIS platforms that use RGB (or RGB triplets) to emulate the print colour of the original map objects.

For the fields identified as 'BGSREF', this is a legacy coding system and is typically a three-digit number which is used to represent the percentage of yellow, cyan and magenta present in the colour. The code can be interpreted using Table 4:

Table 4 Colour ratios

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

For example, the code 912 represents
Yellow (9) = 100% + Cyan (1) = 7% + Magenta (2) = 14%.

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)

5 Licencing the data

5.1 BGS LICENCE TERMS

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 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-query able 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.

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.

5.2 DATA ACKNOWLEDGMENTS

Please use the following acknowledgements when using BGS Geology 10k-25k v3 in images and reports:

DATASET NAME licenced data: 'Derived from BGS Digital Data under Licence (cite your licence number) British Geological Survey © UKRI. All rights reserved.'

DATASET NAME data: ‘Contains British Geological Survey materials © UKRI [year]’

5.3 CONTACT INFORMATION

For all data and licensing enquiries please contact:

BGS Data Services
British Geological Survey
Environmental Science Centre
Keyworth
Nottingham
NG12 5GG
Direct Tel: +44(0)115 936 3143
Email: digitaldata@bgs.ac.uk

6 Limitations

6.1 DATA CONTENT

The BGS Geology 10k-25k v3 dataset 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 10k-25k v3 has been created using the most recent published geological map at 1:10 000 scale or 1:10 560 scale (six-inch to one mile) for older pre-metric maps, if the area has not been revised since about 1970, and 1:25 000 scale data for upland areas. These maps were constructed using geological observations 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.

Whilst every effort is made to ensure all digital data are processed to the same standard; the differing map sources, modes of derivation, and compilation methods (arising from the analogue to digital, and all-digital streams) can cause subtle differences between map tiles in the database. The differences are related to issues of:

- Source scales: e.g., 1: 10 000, 1:10 560 1:25 000 scale of paper originals, as well as recent multi-scale digital data such as satellite imagery or terrain-LiDAR
- Source diversity: e.g., modern maps will utilise a much wider range of spatial information, not just survey observation.
- Source age: e.g., terrain complexity and representation vary with age of survey (geology is extrapolated across terrain information available at the time of survey, modern surveys utilise higher resolution and more precise terrain data)
- Source age: e.g., geological complexity and representation vary with age of survey (complexity and detail is subject to evidence available at the time of survey, older surveys benefit from exposures now obscured by urban growth, whilst recent surveys will be based on the latest concepts of geology and will have far more information derived from sampling and remote sensing techniques)
- Source type: e.g. digitisation of paper and plastic originals can introduce errors of capture relating to issues such as geo-rectification and warping of paper originals, human error (capture, interpretation and classification) and for all-digital surveys – issues concerning accuracy and precision of location (e.g., GPS methods and types))

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.

The BGS Geology 10k-25k v3 dataset comprises digital geological map data at (mostly) 1:10 000 scale presented as 5 x 5 km square tiles based on the Ordnance Survey's National Grid. Currently some 5069 tiles are available.

6.2 SCALE

BGS Geology mapping should be used at an appropriate scale, normally at the same scale as the original paper compilation or generalised variant. The recommended nominal scale is embedded in the BGS Geology data as an attribute (NOM_SCALE).

The BGS Geology 10k-25k v3 data is designed to provide local representation of geology only, and to assist (not replace) any required site-specific geological investigation. 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.

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. You must seek professional advice before making technical interpretations based on the materials provided.

6.3 ACCURACY/UNCERTAINTY

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 1:25 000 scale, for much of Great Britain this is the most detailed geological mapping available.

The mapping accuracy associated with the BGS Geology 10k-25k v3 dataset is nominally +/-1 mm which equates to +/-10 m on the ground, at true scale (+/- 25m in some upland areas). This is only a measure of how faithfully the lines have been captured from the original paper mapping, it is not a measure of the accuracy of the original geological survey.

All geological classifications are based on interpretation of evidence for which no explicit uncertainty is provided. For example: a sharp geological boundary, observed at surface, at a given location using differential GPS, will be captured with greater accuracy (and precision), than a conceptual, gradational boundary, that is postulated to occur beneath a thick layer of superficial materials.

Even at 1:10 000 scale it is sometimes necessary to simplify the geological objects by cartographic generalisation, to enhance visual clarity. Users should NOT use the datasets at finer scales than stated (e.g., less than 1:10 000).

6.3.1 Factors that can affect accuracy and uncertainty differ slightly for the 5 data layers:

6.3.1.1 Bedrock and Superficial deposits

Accuracy and uncertainty for bedrock and superficial features depends heavily on the nature of the rock, or deposits, and the relationship between the different features being mapped. For example, a sharp, planar boundary separating two contrasting lithologies, is likely to be more accurately mapped, with greater certainty than a diffuse or gradational boundary between two similar lithologies. The complexities of the boundaries and heterogeneity of the lithologies is further complicated by the evidence available at the time of survey to enable a surveyor to resolve the map features.

There is an inherent uncertainty for some geological features (such as metamorphic zone characterisation, lateral facies variation, or stratigraphic identification that is heavily dependent upon sampling strategies).

In general, accuracy and uncertainty with depth, varies independently from lateral accuracy/uncertainty, with deeper (generally non-visible) features having much greater uncertainty associated with them, and lower accuracy of spatial representation.

6.3.1.2 Artificial ground

Anthropogenic materials are mobilised continuously by redevelopment of our landscape, and their distribution and form can change significantly over short periods of time.

In areas of significant urban development, artificial deposits of variable thickness and composition, are present everywhere.

Users should be aware that BGS mapping of artificial materials represents a snapshot of what was observed/inferred at the time of survey and may not reflect what has changed since that survey, nor what is currently present.

Not all 1:10 000 scale surveys included capture of artificial features. Capture of made and worked ground, was traditionally associated with only the larger quarrying and mining operations scattered across Great Britain. It is only since the 1990's that a more systematic approach has been taken to capturing such features (and including features such as road embankments and cuttings). There is therefore an inherent uncertainty in the mapped artificial theme associated with the age and remit of the survey.

6.3.1.3 Mass movement

BGS Geology 10k-25k v3 Mass movement deposits represent the mobilised 'slip' materials only and not necessarily the entire area of the landslip feature.

Users should also be aware that early surveys will have only captured the larger land slip deposits.

Later surveys (post 1970's) made greater use of air photography and photogrammetry to identify and map these features more consistently. Modern surveys, utilising LiDAR data can also now detect features obscured by vegetation or urban development. There is therefore an inherent uncertainty in the mass-movement theme associated with the age of the survey.

6.3.1.4 Faulted features

A fault is typically portrayed in BGS Geology 10k-25k v3 as a single line. Users should be aware that this linear representation does not imply any specific dimensions or characteristics to the fault/fault zone. The line merely represents the apparent location of a faulted feature (faults are planes of failure and commonly exist as zones of disrupted materials). It is therefore difficult to provide simple descriptions for accuracy and uncertainty for such features.

The representation of faulting (in terms of geometry, distribution, sense of movement and heterogeneity) are highly dependent upon the evidence available at the time of survey. For example, surveys that have been able to utilise seismic data, may provide a more complete model of fault history and distribution than surveys without. Faults, as bedrock-related features, are characteristically obscured by superficial deposits, soil and vegetation. As such, there are inherent uncertainties associated with them.

For a more detailed discussion of cartographic generalisation and other issues concerning the BGS Geology portfolio of datasets see Smith, 2009.

6.4 ARTEFACTS

Geological maps were originally fitted to a particular topographical base (mostly Ordnance Survey 10k or 25k scale). Care must be taken with interpretations linked to topography, particularly when the vector geological data are displayed on a different topographic base. The geology may not fit a more recent topography for reasons of landscape evolution or survey technique. For example, the alluvium along a river may have been modified by fluvial scour processes since the original survey. Or a geological survey mapped to the terrain shown on a 20th century contour map, will not necessarily align well with a modern airborne-LiDAR derived map.

The BGS Geology 10k-25k v3 dataset also represents data from different episodes of survey. This can result in disparities between interpretations and observations made at the time of those surveys, across different parts of the dataset. Consequently, adjacent geological sheets/tiles (of different survey dates) may not fit seamlessly together spatially, or in terms of lithological description. This can result in some map-sheet 'edges' that exhibit contrasting colours and dissimilar attribution. BGS is working to reduce the occurrence of these as part of its ongoing continuous revision programmes.

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

6.5 DISCLAIMER

The use of any information provided by the British Geological Survey ('BGS') is at your own risk. Neither BGS nor the Natural Environment Research Council or UK Research and Innovation (UKRI) 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.

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7 Frequently asked questions

Q: What does this dataset show?

A: A digital representation of geology via five 'layers' of data suitable for use within mapping software (such as GIS).

Q: What scale are these data provided at?

A: The data are provided for use at approximately 1:10 000 scale (1:25 000 scale in some upland areas).

Q: How accurate is this dataset?

A: The data has been mostly captured from paper mapping at 1:10 000 scale (1:25 000 scale in some upland areas). The quality of capture is estimated to provide +/- 1mm of cartographic accuracy (which represents +/- 10- 25m of accuracy at true scale).

Users should be aware that geological maps are a compilation of observed and inferred features. It is not possible to provide a consistent level of accuracy for all objects in a geological map. For example: a sharp geological boundary, observed at surface, at a given location using differential GPS, will be captured with greater accuracy (and precision), than a conceptual, gradational boundary, that is postulated to occur beneath a thick layer of superficial materials. Further details about geology map accuracy are provided in the 'Limitations' section of this report.

Q: How do the digital maps compare with the paper maps?

A: It is common for BGS Geology 10k_25k content to differ slightly from the information shown on many of the original paper maps. During digital compilation, the digital data is modified to improve nomenclature (to current usage/terminologies), identified errors on printed maps will be periodically corrected and, in some cases, additional or revised geological interpretations (derived from information gathered since the last survey) may have been created. The BGS Geology 10k_25k dataset should be regarded as a dynamic document, subject to continuous update and correction.

Unlike the traditional paper maps, BGS Geology 10k_25k is supplied without a topographic backdrop, cartographic symbology, cartographic legends, generalised vertical sections or other marginalia. It is designed to provide a simple geological backdrop for users to review within digital mapping software. Users are advised to exercise caution if comparing analogue and digital sources of mapping data and to seek further guidance from BGS if they require further clarification.

Q: How often will this dataset be updated?

A: The dataset is subject to ongoing continuous revision, whereby parts of the map are updated as and when further information becomes available to require a map alteration. There is not a specific timetable for all parts of the map. Users can contact enquiries@bgs.ac.uk if they wish to confirm if any new information is available for specific locations since publication date of the digital dataset.

Q: In what formats can these data be provided?

A: The data are provided in a range of vector formats suitable for geographic information systems. Typically, BGS provides this data in ESRI 'shp' and MapInfo 'tab' formats, with additional supporting files to enable use in QGIS and other GIS platforms. Additionally, some original paper maps are available separately as raster scanned images.

Q: What is the difference between this data and BGS Geology 50k dataset?

A: This dataset represents the highest resolution of geology mapping by BGS. The BGS Geology 50k dataset is largely derived from it via cartographic generalisation and it is managed via an independent editorial workflow. As a result, the two different datasets are unlikely to exactly 'match'. Overall, users should be able to determine the 'familial relationship' between this dataset and the derived 50k mapping. However, there may be small parts of either dataset that have been more recently been updated than the other, and so there may be spatial content, or text attribution that differs between the two at site-scope. Users should pay attention to the metadata provided in both datasets with respect to survey and publication dates. They should seek expert advice, or further information from BGS, if they are unsure about differences in the datasets at specific locations.

This dataset does not have full coverage across Great Britain in digital form (whereas the BGS Geology 50k dataset is a nearly full-coverage product).

Q: Should I use this dataset instead of the 50k dataset?

A: Choosing which dataset to use depends upon your needs and location. The 50k dataset is available for 99% of Great Britain, whereas the 10k/25k is limited to c. 50%. There may also be analogue paper maps at the larger scale available on the BGS Maps portal (https://www.bgs.ac.uk/information-hub/bgs-maps-portal/). For site investigation purposes BGS typically recommends using the highest resolution (10k-25k) mapping available. Where more than one scale of mapping is available both datasets can be used together. However, users should be aware that as separate datasets of differing scales and vintages, they will not always perfectly match. In a small number of areas, there will be differences due to age of mapping and pending updates. In such cases further information from BGS, or a qualified geoscientist can be sought.

Q: What is the difference between this data and that shown in the BGS GeoIndex and BGS Geology Viewer app?

A: The BGS Geoindex and BGS Geology Viewer platforms show the derived BGS Geology 50k dataset. The BGS Geology 10k-25k v3 dataset is of a higher resolution, but less complete coverage.

Q: What do I do if I think I have spotted an error in the data?

A: Please contact enquires@bgs.ac.uk to let us know and discuss the issue with you.

Q: Can I use this dataset as part of a commercial application?

A: Please refer to the licencing terms supplied alongside the dataset. For further queries regarding the licencing terms of our products, please contact digitaldata@bgs.ac.uk.

Appendix 1

LITHOLOGY

Rocks may be described in several 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 10k-25k v3.

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 using 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="12">Litho-stratigraphic units</td><td></td><td></td><td>Formation J</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Formation K</td><td></td><td rowspan="6">Group C</td><td rowspan="10">Supergroup B</td></tr>
<tr><td></td><td></td><td>Formation L</td><td rowspan="2">Subgroup F</td></tr>
<tr><td></td><td></td><td>Formation M</td></tr>
<tr><td>Bed W</td><td rowspan="2">Member U</td><td rowspan="3">Formation N</td><td rowspan="3"></td></tr>
<tr><td>Bed X</td></tr>
<tr><td></td><td>Member V</td></tr>
<tr><td></td><td></td><td>Formation O</td><td rowspan="2">Subgroup G</td><td rowspan="4">Group D</td></tr>
<tr><td></td><td></td><td>Formation P</td></tr>
<tr><td></td><td></td><td>Formation R</td><td rowspan="2">Subgroup H</td></tr>
<tr><td></td><td></td><td>Formation S</td></tr>
<tr><td>Bed Z</td><td></td><td>Formation T</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 a fundamental rock unit for mapping purposes at 1:10 000 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 sub-suite, and may itself comprise several intrusions (see Table 6). 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-meta-morphic 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 several 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 10k-25k v3, 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 time chart (https://www.bgs.ac.uk/discovering-geology/fossils-and-geological-time/) and the latest version of the ICS time chart (https://stratigraphy.org/chart) can be used to discover further information about chrono-stratigraphy 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 10k-25k v3 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 10k-25k v3 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 10k-25k v3 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. **Information on fault throw (hanging wall) remains incomplete and subject to change in**

BGS Geology 10k-25k v3. 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 10k-25k v3 depending upon on the scale of the fold feature (e.g., micro folds may not be shown at the 1:10 000 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.

Glossary

Term	Explanation
Anthropogenic	Environmental change caused by or resulting from the influence of people or their activities either directly or indirectly.
Artificial	Ground surface has been significantly modified by human activity. Examples include recent anthropogenic or artificially modified ground where the ground surface has been significantly modified by human activity including quarrying, landscaping, land-raise, cuttings and embankments.
Bedrock	The main mass of rocks forming the earth, laid down prior to 2.588 million years ago. Present everywhere, whether exposed at the surface in rocky outcrops or concealed beneath superficial deposits, artificial ground or water. Formerly called solid.
Chronostratigraphic	The classification (within a defined hierarchy) of rock successions is based on relative age and time relationships. Chronostratigraphical ages (e.g., Jurassic) are defined but the International Commission on Stratigraphy (https://stratigraphy.org/).
Compilation	The process or output of bringing together combinations of data to create a map output.
Conjectural	A conjectural geological feature is one where there is no direct evidence of it existing, but indirect evidence is sufficient for a geologist to propose its existence to satisfy the overall conceptual model being shown by the map. For example, a non-observed fault, can be conjectured to exist beneath superficial cover to explain the juxtaposition of two bedrock types inferred from other observations.
Desktop -modelling	A virtual model or concept developed from compiled evidence, rather than solely field-based activities.
Fault	Plane or zone of displacement. An area where bodies of rock have been displaced relative to each other by geological forces. Faults are commonly represented on maps as lines but may represent zones and volumes of failed materials.
Field survey	A strategic campaign to capture observations and measurements of geological features in situ.
Geographical Information System	Geographic Information Systems (GIS) provides accurate information, assistance, support, and maintains and creates information to aid in the development of maps and data analysis.
Geohazard	Geological and environmental conditions, involving long and short-term processes which may lead to widespread damage. There are many different types of geohazard with different natural and artificial processes causing them to occur. All have the potential to create problems for development of the human environment and threats to the safety and well-being of people. Geohazards can develop quickly (seconds or minutes) in response to the processes that drive them, or take tens, hundreds, or thousands of years to develop to a point where they pose a danger. They are found in most parts of the world, including marine and fluvial environments.
Geology	The study or science of the earth, its history, and its life as recorded in the rocks; includes the study of geologic features of an area, such as the geometry of rock formations, weathering and erosion, and sedimentation.
Georectification	To correct positional displacement with respect to the surface of the Earth. This process is commonly applied to maps that require minor adjustments to their

	portrayed shape, and to enable identification of map coordinates, relative to real –world coordinates.
Inferred	An inferred geological feature is one where there is no direct evidence of its existing, but indirect evidence is sufficient for a geologist to propose its existence. For example, a landform, vegetation change, or soil change can be used to 'infer' that the underlying geology has changed.
Light Detection And Ranging (LiDAR)	System consisting of 1) a photon source (frequently, but not necessarily, a laser), 2) a photon detection system, 3) a timing circuit, and 4) optics for both the source and the receiver that uses emitted laser light to measure ranges to and/or properties of solid objects, gases, or particulates in the atmosphere.
Lithodemic	Bodies of rock which do not conform to the Law of Superposition (i.e., in any undisturbed sequence of rocks deposited in layers, the youngest layer is on top and the oldest on bottom) are described as lithodemic. They are generally composed of intrusive, highly deformed, or metamorphic rocks, determined and delimited based on rock characteristics. Their boundaries may be sedimentary, intrusive, extrusive, tectonic or metamorphic. Their classification is by lithology (rock type) and form or mode of origin e.g., a LITHO-MORPHO-GENETIC grouping.
Lithology	Rocks maybe defined in terms of their general characteristics of appearance: colour, texture, and composition. Some lithologies may require a microscope or chemical analysis for the latter to be fully determined.
Lithostratigraphic	Age and lithology. 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). 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 (order) in a formal hierarchy. The main lithostratigraphic ranks in this hierarchy are Bed (lowest)>Member,>Formation>Subgroup>Group>Supergroup (highest). The units are usually named after a geographical locality, typically the place where exposures were first described.
Mass movement	Primarily superficial deposits or weathered bedrock that have moved downslope under gravity to form landslips.
Observed	An observed geological feature is one that has provided some form of direct measurement (physically seen or sampled).
Peri-urban	Areas that are in some form of transition from strictly rural to urban. These areas often form the immediate urban-rural interface and may eventually evolve into being fully urban. Peri-urban areas are places where people are key components: they are lived-in environments.
Raster	Raster data can be thought of as being like a digital photograph. The entire area of the map is subdivided into a grid of tiny cells, or pixels. A value is stored in each of these cells to represent the nature of whatever is present at the corresponding location on the ground.
Resource	Any geological material that has some form of economic value
Scale	The relation between the dimensions of features on a map and the geographic objects they represent on the earth, commonly expressed as a fraction or a ratio. A map scale of 1/100,000 or 1:100,000 means that one unit of measure on the map equals 100,000 on the earth.

Stratigraphy	The study of, or classification of rocks by their relative or absolute ages. Stratigraphy identifies rocks into groups of similar ‘ages’ and identifies the oldest and youngest events and sequences that led to their occurrence.
Superficial	The youngest geological deposits formed during the most recent period of geological time, the Quaternary. They date from about 2.6 million years ago to the present.
Vector	A representation of the spatial extent of geographic features using geometric elements (such as point, curve, and surface) in a coordinate space.

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 library catalogue is available at: https://envirolib.apps.nerc.ac.uk/olibcgi.

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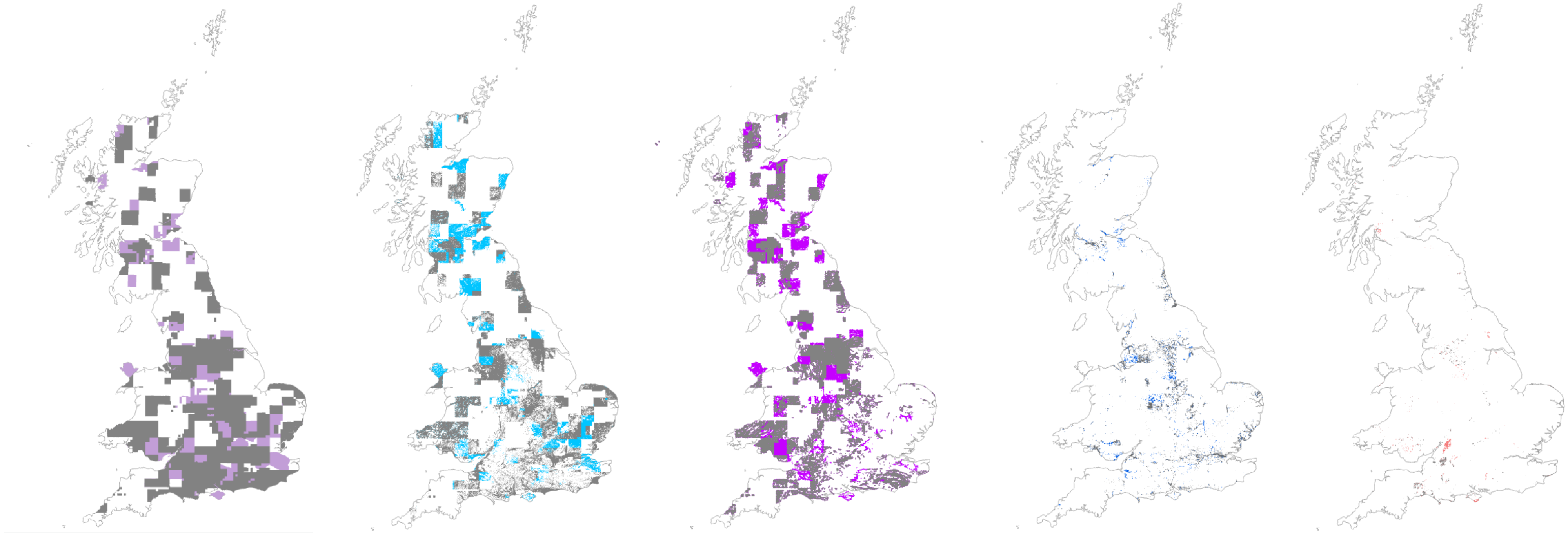
Appendix 2

Locations of new or modified content in Version 3 by comparison with V2 (V2 coverage shown in grey, V3 in colour)



Bedrock | Superficial | Linear | Artificial | Mass movement

Figure 4 Bedrock changes (purple), Superficial changes (light blue), Linear changes (pink), Artificial changes (dark blue), Mass-movement changes (brown). Coastline Contains OS data © Crown copyright and database right 2024.