British Geological Survey
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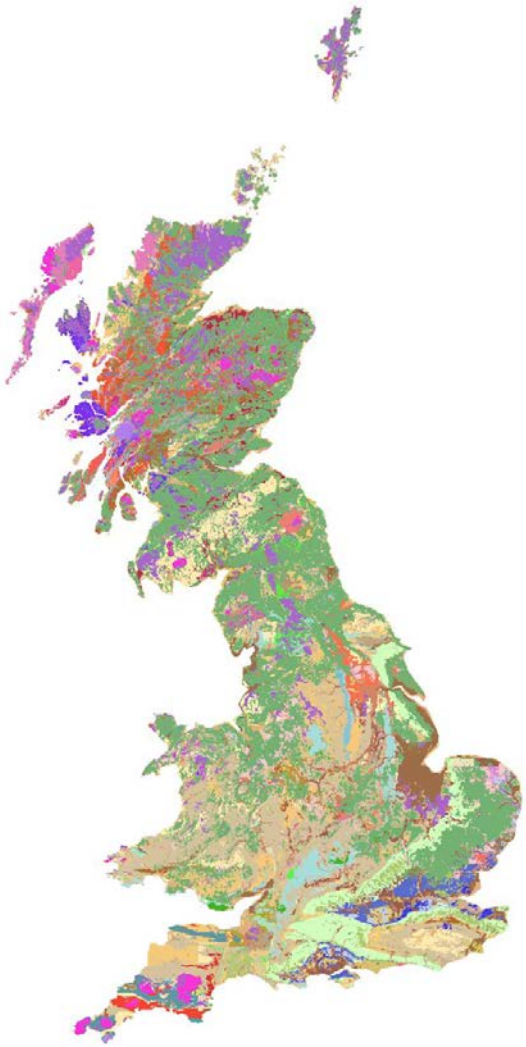
User Guide: Soil Parent Material 1kilometre dataset.

Environmental Modelling
Internal Report OR/14/025



BRITISH GEOLOGICAL SURVEY

ENVIRONMENTAL Modelling

INTERNAL REPORT OR/14/025

User Guide: Soil Parent Material 1kilometre dataset.

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Keywords

Parent Material, Soil,UKSO.

National Grid Reference

SW corner 999999,999999
Centre point 999999,999999
NE corner 999999,999999

Map

Sheet 999, 1:99 000 scale, Map name

Front cover

Soil Parent Material 1km dataset.

Bibliographical reference

LAWLEY., R. USER GUIDE: SOIL PARENT Material 1 Kilometre dataset. 2012. User Guide: Soil Parent Material 1km dataset.. *British Geological Survey Internal Report*, OR/14/025. 20pp.

Keyworth, Nottingham British Geological Survey 2012

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1 Introduction

This document provides information for users of the Soil Parent Material 1km dataset. The Soil Parent Material 1km (SPM1k) database is part of a series of GIS maps designed to help environmental scientists and consultants assess the characteristics of the 'near-surface' weathered zone. In particular, the data focuses upon the material from which top soils and subsoils (A and B horizons) develop (i.e. from the base of pedological soil down to c. 2-3m).

This Soil Parent Material1km resolution dataset is provided as a free-to-use dataset under the Open-Government License. The 1km dataset is derived from the standard 1:50,000 scale Soil Parent MaterialV6 dataset by spatial generalising (onto a regular vector grid of 1km cell size) the dominant Parent Material type onto a 1km resolution vector grid. Each grid cell being attributed seven fields of simple information derived from the dominant parent type.

The attribution of the dataset mirrors that available within the UK Soil Observatory. www.UKSO.org. The 1km resolution makes the data an ideal vector layer to use with other freely available layers from the UKSO.

1.1 Background

In 2005 the British Geological Survey initiated a development programme to produce thematic datasets that identified and portrayed a variety of parent material and soil properties in Great Britain.

A 'parent material' is a geological deposit over, and within which, a soil develops. Typically, the parent material is the first recognisably geological deposit encountered when excavating beneath the soil layer. It represents the very-near-surface geology. In general, the geological deposits closest to the ground surface are the most weathered, whilst the deeper deposits are less so. The interface between soil and parent (geology) can vary from a sharp, clearly defined boundary, to a diffuse continuum with no distinctive point of transition.

"The major soil groups [in the UK]… are distinguished by broad differences in the composition or origin of the soil material" (Avery, 1980). A soil's parent materials play a vital role in determining soil-type. Typically, parent material characteristics control three primary characteristics of their overlying soils:

- Texture
- Gross soil Chemistry (geo-genic component)
- Permeability-Porosity (drainage)

A range of material characteristics (physical and chemical) are implicitly defined in the typical geological rock/deposit descriptions provided in many BGS products and most geologists are able to interpret the information from their own experience and knowledge. However, these characteristics are easier to use (by non-geologists) when explicitly defined, as they are in the Soil Parent Materialdatabase.

The Soil Parent Material 1km data has explicitly defined attributes for the following characteristics:

- European Soil Bureau PM type
- Soil Texture
- Soil Group (generalised soil texture)

- PM texture
- PM Carbonate Content
- Soil Layer thickness

1.2 Who would benefit from the dataset?

It is envisaged that 'Parent Materials 1km' is of interest to a wide range of users working in the field of environmental science (from ground engineering and landscape modelling to climate change impact assessment). The dataset has been designed for a diverse user-base and simply presents BGS' geological and pedological spatial data in a manner that is more flexible for GIS-aware environmental scientists. A basic understanding of geology and soils is recommended so that users can fully utilise the dataset but any user with a grasp of physical geography should be able to work with the dataset. The database sets out simplified, qualitative descriptions of 6 basic PM and soil characteristics available from the UKSO and mySoil smartphone app. The 1km dataset is designed to work with similar 1km resolution data available from BGS and other organisations working in soil research. More expert users may want to use the high resolution 1:50,000 scale dataset to integrate with climate, land use and terrain data to create high-resolution digital soil models.

1.3 What the dataset shows

The Soil Parent Material 1km dataset is a vector grid (sometimes called a fishnet-grid) with 1km x 1km cell dimensions. It is derived from the standard 1:50,000 scale Soil Parent Material v6 dataset by spatial generalised of the dominant Parent Material type (less spatially prevalent parent materials being absorbed into the dominant class). Dataset attribution is inherited from the dominant parent and comprises the following information.

1.3.1 European Soil Bureau definition of Parent Material type (ESB_DESC)

The European Soil Bureau (ESB) definition of Parent Material type provides the 'most applicable', European definition of parent material type for each map unit. The ESB 'code' and description for a parent material is defined in the Georeferenced Soil database for Europe (Finke et al, 2001) and is summarised in Appendix 1. Multi-lithic parent materials (e.g. layered units of two or more contrasting lithologies) are represented by two or more codes separated by '_'. The ESB description is useful for users considering integration of this database into European soil/geology databases. Alternative codes and definitions are available within the high resolution, licensed dataset, that provide opportunities for reclassifying the parent type via a number of hierarchical classification systems.

1.3.2 Carbonate Content (CARB_CNTNT)

This field classifies all forms of carbonate content in each parent material (calcite, dolomite, siderite) as a simple ranking of: none, low, moderate or high (with unknown or variable for heterolithic and multilithic parent units). As a very general rule soils that have formed over carbonate-rich parent material typically have large carbonate contents which means they strongly buffer acidity from agricultural or atmospheric sources. The Parent Material Carbonate Content classification is based on expert judgment of the likely content of carbonate ($Mg/CaCO_3$) in the total rock-mass of each parent material. For example, High carbonate content would be expected for a chalk or limestone parent material type; Low carbonate content would be representative of weakly, calcite-cemented sandstone. The term variable is used where the parent material comprises two or more distinct lithologies e.g. interbedded limestone and mudstone where it is not possible to clearly identify the precise parent type at any given location. Users should note that land management practices and natural weathering processes of parent

materials play a significant role in controlling carbonate content (it has not been possible to factor in these influences within the scope of this dataset) and so the classes shown in this dataset should be regarded as wholly 'indicative'.

1.3.3 Parent Material Grain Size (PMM_GRAIN)

This is a generalised textural description of the Parent Material. The grain-size values are derived from analyses of samples taken from the parent material and also expert judgement (based on field survey and description of the deposits). Where a parent material comprises more than one type of deposit, a range of classes is recorded. Deposits that are known to be heterolithic are identified by the term 'mixed'. Note that geologists use different grain-size descriptions for rocks originating from sedimentary and igneous lithologies and that peat is not attributed with a grain-size term (peat is used to denote areas of peatland where we hold no alternative grain-size information).

1.3.4 Soil Group (SOIL_GROUP)

This is a generalised description of soil texture found over different parent material types, in terms of Heavy, Medium or Light soils as broadly indicated in the Defra Cross Compliance Guidance for Soil Management (Defra, 2006).

These generalised soil texture groupings are derived by comparing samples of measured soil textures (%clay, %silt and %sand) against a simplified grain-size ternary plot. Note that this map uses terms that refer to light soils (i.e. sand/silt rich), medium soils (i.e. loams) and heavy soils (i.e. clay-rich). The classifications are based on analyses of archived BGS G-BASE and geotechnical samples as well as expert judgment (where sample data is not available). Most parent materials generate a broad range of soil textures so these groupings should be regarded as 'indicative'. The 'Mixed or Organic' classification denotes highly variably textured soils or the presence of peat (no texture data is available for peaty soils).

1.3.5 Soil Texture (SOIL_TEX)

This is a general classification of soil texture derived from measured samples of soils overlying different parent materials. Soil texture classes are based on a UK classification of soil texture. These soil texture classifications are derived by comparing samples of measured soil textures (%clay, %silt and %sand) against the soil grain-size ternary plot designed by The National Soil Resources Institute (Hodgson, 1997). The classifications are based on analyses of archive G-Base and geotechnical samples as well as expert judgment (where sample data is not available). Note that the map uses terms that refer to: Sandy soils, Silty soils, Clayey soils and Loamy soils with additional indicators for the presence of Chalk fragments (Chalky) and Peat (Peaty). Most parent materials generate a broad range of soil textures so these terms should be regarded as 'indicative'. The 'Varied, Locally Peaty' classification denotes variably textured soils that are typically found in alluvial systems.

1.3.6 Soil layer thickness (SOIL_DEPTH)

This is a general classification of soil thickness (soil depth) typically found on different Parent Material types. These soil thickness classifications are derived by using expert judgement to compare records of measured soil depth observed from borehole records with engineering strength characteristics of the underlying Parent Materials. Five categories of soil thickness are provided ranging from deep to shallow. As a rule of thumb, these categories are based on the ability to manually dig (with a spade) without being hindered by a substrate that is too strong to excavate (i.e. layers of solid rock, dense gravel, or very stiff clays). An example of a deep soil would be one developed over unconsolidated, clayey Quaternary deposits, and an example of a shallow soil would be one found in areas underlain by chalk or limestone. Users should note that land management practices and natural weathering and accumulation (or erosion) processes of

soil materials play a significant role in controlling field-scale soil depth (it has not been possible to factor in these influences within the scope of this dataset).

1.3.7 How the dataset was created

Data was collated and interpreted from a number of different sources currently held by BGS.

The primary datasets used for the 'Soil Parent Material 1km' dataset are:

- Soil Parent Material Map V6 dataset (The main spatial framework)
- DiGMapGB PLUS 'Excavatability' dataset
- GBASE (Geochemical and related observational data)
- Single Onshore Borehole Index (SOBI)
- BGS National Geotechnical Properties Database (NGPD)
- Industrial Minerals Assessment Unit (IMAU) Sand and Gravel dataset

These datasets have contributed underlying information to the SPM1km attributes as follows:

	ESB type	Carbonate Content	Parent Material Grain size	Soil Group	Soil texture	Soil Thickness
PMMv6 50k	Y	Y	Y	Y	Y	
DiGMapGBPLUS Excavatability						Y
GBASE		Y		Y	Y	Y
SOBI		Y	Y	Y	Y	Y
NGPD			Y	Y	Y	Y
IMAU		Y	Y	Y	Y	Y

The Soil Parent Material 1km dataset has a simple sequential workflow for each attribute component and an automated spatial generalisation procedure from the 1:50,000 scale SPMM v6 dataset:

1. Identify measurements and observations from archive sample records and rock descriptions that relate to the selected attributes (e.g. carbonate chemistry).
2. Categorise the observations into classes/groups of similar behaviours (e.g. High, Low), where possible using published standards of classification such as BS 5930, Eurocode 7 or similar.
3. Assess whether the range of available evidence statistically supports the range of possible classes (using typical tests such as ANOVA), or whether expert judgement is required to subdivide/combine categories (e.g. it is not viable to predict an accurate CaCO3 content (as %) across Great Britain, but generic classes of High, Medium, Low can be delineated/estimated).
4. Assess the range of lithostratigraphic variation of geological materials across Great Britain, in terms of the categories and classes identified in steps 2 & 3. Using combined

expert-judgement and spatial analyses create a ‘lookup’ dataset of expected attributes (material characteristics and behaviours) per lithostratigraphic unit.

5. Combine the spatial (map) components of the Soil Parent Material v6 datasets with the ‘lookup’ dataset created in step 4 (using standard GIS ‘spatial and/or attribution join’ techniques to create new ‘map’ of fill characteristics.
6. Apply a fish-net generalisation to the dataset, by identifying the dominant parent material type (by area) on a 1km by 1km vector grid. Each grid cell is assigned the classification of the dominant feature type.
7. Submit data for standard BGS digital-data checking procedures (to assess completeness and cleanliness of content).

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Categorisation of the data and assignment of classes have been mostly made by expert judgement in order to create ‘look up tables’ of lithostratigraphic rock type and associated engineering properties. The methods used are similar to those described in the methodology report for the underpinning Soil Parent Material v6 dataset (Lawley, 2008). Assignments of characteristics have been made at the ’formation’ level of lithostratigraphic classification of rock/deposit type.

Spatial data-creation and fill-attribution has been completed using standard ESRI ARCGIS (EDITOR Version) software.

2 Technical information

2.1 Field descriptors

The data fields included in this dataset are as follows:

ESB DESC	CARB CNTNT	PMM GRAIN	SOIL GROUP	SOIL TEX	SOIL DEPTH	PMM1k UID	VERSION
Text description	Text description	Text description	Text description	Text description	Text description	Unique Identifier	Data descriptor

Each field comprises some form of text description or classification which follows a basic definition of its characteristics as described in the following tables:

2.1.1 ESB_DESC

The ESB descriptions are defined in Appendix 1. There are 155 ESB codes defined in the SPM1km dataset.

2.1.2 CARB_CNTNT

The carbonate content descriptions are defined as follows:

Term used	Definition
High	Parent type has a high $CaCO_3$ content due to its primary mineralogy e.g. Chalk.
Variable(high)	Parent type has a variable but possibly high $CaCO_3$ content due to lithological variation e.g. Interbedded limestone and calcareous mudstone beds.
Mod	Parent type has a moderate $CaCO_3$ content due to its primary mineralogy e.g. dolomite.
Variable	Parent type has a variable (high to low) CaCO3 content due to heterolithic distribution of carbonate e.g. Till with chalk-gravel.
Low	Parent type has a low $CaCO_3$ content due to its primary mineralogy e.g. weakly calcareous-cemented mudstone.
Variable(low)	Parent type has a variable but typically low $CaCO_3$ content e.g. mudstone with intermittent, weakly-calcareous, sandstone beds.
None	Parent type has a no primary $CaCO_3$ content.
Unknown	Parent materials whose precise lithology is unclear (generally highly variable at short scales) or from a location that no mineralogical/geochemical data is available to confirm primary mineralogical content.
Not applicable	No data applicable (typically inland water bodies).

In the 1:50,000 scale dataset this field is called CaCO3_CNTNT.

2.1.3 PMM_GRAIN

The Parent Material Grain size descriptions are defined as follows:

Term used	Definition	Typical Particle size (mm)
Grain size class (non-igneous parent)		
Argillaceous (Argillic)	Materials that are dominantly fine grained (clay and silt grade)	< 0.06
Arenaceous	Materials that are dominantly medium grained (fine to medium sand grade)	0.06 - 2.0
Rudaceous	Materials that are dominantly coarse grained (coarse sand to gravel grade)	2.0 +
Peat*	Material is Peat	NA
Grain size class (igneous parent)		
Fine	Materials that are dominantly composed of fine crystals.	< 0.25
Medium	Materials that are dominantly composed of medium crystals.	0.25 > 2
Coarse	Materials that are dominantly composed of coarse crystals.	2.0 +
Not Applicable	No data applicable (typically inland water bodies).	

2.1.4 SOIL_GROUP

The Soil Group descriptions (broad trends in soil texture as commonly used by DEFRA are defined as follows:

Term used	Definition
Heaviest soils	Soils that are generally clay-rich.
Medium and/to Heavy soils	Soils that range from clay-rich to loamy (generally because of heterolithic parent materials, such as interbedded mudstones and sandstones).
Medium soils	Soils that are generally loamy.
Medium and/to Lightest soils	Soils that range from loamy to silt-rich or sand-rich (generally because of heterolithic parent materials, such as interbedded sandstones and siltstones).
Lightest Soils	Soils that are generally sand-rich or silt-rich.
Mixed or Organic soils	Soils that exhibit highly variable soil textures or the presence of Peat (generally due to the heterolithic nature of the parent material or is mode of origin).
NOT APPLICABLE	No data applicable (typically inland water bodies).

2.1.5 SOIL_TEX

The Soil textures in the PMM1km dataset are concatenated texture codes that cover the basic Soil texture descriptions are defined as follows:

	Definition
Clay	Soil is generally dominated by clay grade particles (< 0.002mm dia)
Silt	Soil is generally dominated by silt grade particles (0.002mm < 0.06mm dia)
Sand	Soil is generally dominated by sand grade particles (0.06mm <2.0mm dia)
Loam	Loam soils are soils with a distributed/even mix of particle sizes
Peat	**Not** a texture term, but defines areas dominated by Peat materials
Moderators	
Clayey-	This terms indicates that the dominant/ typical texture is moderated by a component of clay particles
Silty-	This terms indicates that the dominant/ typical texture is moderated by a component of clay particles
Sandy-	This terms indicates that the dominant/ typical texture is moderated by a component of clay particles
Peaty-	This terms indicates that the dominant/ typical texture includes a component of Peat
Chalky-	This terms indicates that the dominant/ typical texture includes a component of Chalk (as sand grade or gravel-grade fragments)

2.1.6 SOIL_DEPTH

The Soil depth descriptions (broad trends in soil thickness) are defined as follows:

Term used	Definition
Deep	A thick soil profile is likely. Soil (and any underlying parent Material) should be **easily** dug to a depth of ***more*** than **1m**.
Deep-intermediate	The soil profile may vary from thick to intermediate. Soil (and any underlying Parent Material) ***can*** be dug to a depth of 1m and ***possibly*** more in some places.
Intermediate	A 'typical' soil profile is likely. Soil (and any underlying Parent Material) ***can*** be dug to a depth of **1m**
Intermediate-shallow	The soil profile may vary from thin to intermediate. The underlying Parent Material is ***potentially*** difficult to dig at depths greater than 0.5m
Shallow	A thin soil profile is likely. Digging the Parent Material beneath the soil will be ***extremely*** difficult at a depth of 0.5m (or possibly less)
Not applicable	No data applicable (typically inland water bodies)

2.1.7 PMM1k_UID

This field uniquely identifies each object in the map. It is used for auditing and identification purposes.

2.1.8 VERSION

This field identifies the dataset (it is set to DPPMM_1km_V1).

2.2 Additional information

2.3 Map scale

The Soil Parent Material 1km dataset is produced for use as a 1kilometre resolution vector grid (1000 m by 1000 m ground resolution).

The data are released in ESRI shapefile formats. Other formats such as MapInfo TAB are available on request. The standard data supplied to customers has polygons in a single layer or theme, with 6 attribute fields.

2.4 Coverage

Data is provided to indicate the Parent materials and soils across Great Britain (excluding Isle of Man).

2.5 Data history

This is the first version of the Soil Parent Material 1km dataset. BGS is continually surveying and resurveying, extending, improving and updating the underlying geological maps and databases.

Version 1 (released 2014): Derived from BGS Parent Material Map version 6. More details on this product can be found at this website http://www.bgs.ac.uk/products/onshore/soilPMM.html

2.6 Limitations

The PMM 1km datasets has been developed at cell resolution of 1km x 1km and must not be used at finer resolution. All spatial searches against the data should consider the limitations of spatial comparison at this kilometre scale.

Local conditions may vary and this dataset should not replace detailed site investigations. Further detail of the geology or parent material may be available on more detailed 1:10,000 scale or 1:50,000 scale geological maps.

The spatial distribution of the data is limited by the spatial accuracy and resolution of the digital geological map data (DiGMapGB-50 V6. Spatial mismatches of parent material related to mismatches in lithology type (i.e. variation in LEX_RCS across map-sheet boundaries) are unavoidable, and require resolution by reference to higher resolution map information. Further detail of the geology or parent material may be available on more detailed 1:10,000 scale or 1:50,000 scale geological maps.

The PMM 1km data are created as vector polygons and are available in a range of GIS formats, including ArcGIS (.shp), ArcInfo Coverages and MapInfo (.tab). More specialised formats may be available but may incur additional processing costs.

The PMM 1km dataset is concerned with the properties and potential use of NATURAL geological deposits and conditions only. It does NOT cover any man-made constructions or materials.

The PMM 1km is based on, and limited to, an interpretation of the records in the possession of The British Geological Survey at the time the dataset was created.

An indication of the typical characteristics of a rock or soil does not necessarily mean that the properties are consistent throughout the outcrop. Such an assessment can only be made by inspection of the area by a qualified professional.

2.7 Licensing information

To encourage the use and re-use of this data we have made the data within Parent Materials 1km available under the Open Government Licence, subject to the following acknowledgement which should be included in any material that reproduces or uses the BGS materials or data: "Contains British Geological Survey materials ©NERC [year]". The terms of use for every product under OpenGeoscience are displayed clearly at the top of every page.

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2.8 Contact information

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3 Appendix 1

European Soil Bureau Descriptions of Parent Materials

Major Class	Group		Type		Subtype	
100 Consolidated clastic sedimentary rocks	110	psephite or rudite	111	conglomerate	1111	pudding stone
			112	breccia		
	120	psammite or arenite	121	sandstone	1211	calcareous sandstone
					1212	ferruginous sandstone
					1213	clayey sandstone
					1214	quartzitic sandstone / orthoquartzite
					1215	micaceous sandstone
					1216	feldspathic sandstone
			122	arkose		
			123	greywacke	1231	feldspathic greywacke
	130	pelite, agillite lutite or	131 132	claystone/ mudstone siltstone	1311 1312	kaolinite bentonite
	140	facies rocks bound	141 142	flysch molasse	1411 1412 1413	sandy flysch clayey and silty flysch conglomeratic flysch
200 Sedimentary rocks (chemically precipitated, evaporated, or of organogenic or biogenic origin)	210	calcareous rocks	211	limestone	2111 2112 2113 2114 2115 2116	hard limestone soft limestone marly limestone chalky limestone detrital limestone carbonaceous limestone
					2117	lacustrine or freshwater limestone
					2118	travertine / calcareous sinter
					2119	cavernous limestone
			212	dolomite	2121 2122	cavernous dolomite calcareous dolomite
			213	marlstone		
			214	marl	2141 2142	chalk marl gypsiferous marl
			215	chalk		
	220	evaporites	221 222 223	gypsum anhydrite halite		
	230	siliceous rocks	231	chert, hornstone, flint		
			232	diatomite / radiolarite		

300 Igneous rocks	310	acid to intermediate plutonic rocks	311 312 313 314	granite granodiorite diorite syenite	3131 3132	quartz diorite gabbro diorite
	320	basic plutonic rocks	321	gabbro		
	330	ultrabasic plutonic rocks	331 332	peridotite pyroxenite		
	340	acid to intermediate volcanic rocks	341 342	rhyolite dacite	3411 3412	obsidian quartz porphyrite
			343 344 345	andesite phonolite trachyte	3431 3441	porphyrite (interm.) tephritic phonolite
	350	basic to ultrabasic volcanic rocks	351 352 353	basalt diabase pikrite		
	360	dike rocks	361 362 363	aplite pegmatite lamprophyre		
	370	pyroclastic rocks (tephra)	371 372 373 374	tuff / tuffstone tuffite volcanic scoria volcanic breccia	3711 3712 3713 3721 3722 3723	agglomoratic tuff block tuff lapilli tuff sandy tuffite silty tuffite clayey tuffite
			375	volcanic ash		
			376	ignimbrite pumice		
400 Metamorphic rocks	410	weakly metamorphic rocks	411 412	(meta-)shale / argillite slate	4121	graphitic slate
	420	acid regional metamorphic rocks	421 422 423 424 425 426	(meta-)quartzite phyllite mica schist gneiss granulite (sensu stricto) migmatite	4211	quartzite schist
	430	basic regional metamorphic rocks	431	greenschist	4311 4312 4313	prasinite chlorite schist talc schist
			432 433	amphibolite eclogite		
	440	ultrabasic regional metamorphic rocks	441	serpentinite	4411	greenstone
	450	calcareous regional metamorphic rocks	451 452	marble calcschist, skarn		

	460	rocks formed by contact metamorphism	461 462 463	contact slate hornfels calcsilicate rocks	4611	nodular slate
	470	tectogenetic metamorphic rocks or cataclastic metamorphism	471 472 473	tectonic breccia cataclasite mylonite		
500 Unconsolidated deposits (alluvium, weathering residuum and Slope deposits)	510	marine and estuarine sands	511 512	pre-Quaternary sand Quaternary sand	5111 5121 5122	Tertiary sand Holocene coastal sand with shells delta sand
	520	marine and estuarine clays and silts	521 522	pre-Quaternary clay and silt Quaternary clay and silt	5211 5212 5221 5222	Tertiary clay Tertiary silt Holocene clay Holocene silt
	530	fluvial sands and gravels	531	river terrace sand	5311	river terrace sand
			532	or gravel flood plain sand or gravel	5312 5321 5322	river terrace gravel flood plain sand flood plain gravel
	540	fluvial clays, silts and loams	541	river clay and silt	5411 5412 5413	terrace clay and silt terrace loam floodplain clay and silt
			542	river loam		
			543	overbank deposits	5431 5432	floodplain clay and silt floodplain loam
	550	lake deposits	551	lake sand and delta sand		
			552	lake marl, bog lime		
			553	lake silt		
	560	residual and redeposited loams from silicate rocks	561	residual loam	5611 5612	stony loam clayey loam
			562	redeposited loam	5621	running-ground
	570	residual and redeposited clays from calcareous rocks	571	residual clay	5711 5712 5713 5714 5715	clay with flints ferruginous residual clay calcareous clay non-calcareous clay marly clay
			572	redeposited clay	5721	stony clay
	580	slope deposits	581	slope-wash alluvium		
			582	colluvial deposits		
			583	talus scree	5831	stratified slope

						deposit
600 Unconsolidated glacial deposits / glacial drift	610	morainic deposits	611	glacial till	6111	boulder clay
			612	glacial debris		
	620	glaciofluvial deposits	621	outwash sand, glacial sand		
			622	outwash gravel, glacial gravel		
	630	Glacio-lacustrine deposits	631	varves		
700 Eolian deposits	710	loess	711	loamy loess		
			712	sandy loess		
	720	eolian sands	721	dune sand		
			722	cover sand		
800 Organic materials	810	peat (mires)	811	rainwater fed moor peat (raised bog)	8111	folic peat
					8112	fibric peat
					8113	terric peat
			812	groundwater fed bog peat		
	820	slime and ooze deposits	821	gyttja, sapropel		
	830	Carbon-aceaous rocks (caustobiolite)	831	lignite (brown coal)		
			832	hard coal		
			833	anthracite		
900 Anthropogenic deposits	910	redeposited natural materials	911	sand and gravel fill		
			912	loamy fill		
	920	dump deposits	921	rubble / rubbish		
			922	industrial ashes and slag		
			923	industrial sludge		
			924	industrial waste		
	930	organic materials				

4 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: http://geolib.bgs.ac.uk.

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