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# BGS classification of lithodemic units: proposals for classifying tectonometamorphic units and mixed-class units

UK Geoscience Framework

Research Report RR/12/02



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# BGS classification of lithodemic units: proposals for classifying tectonometamorphic units and mixed-class units

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# Summary

Lithodemic units are those mappable geological units that are defined and delimited primarily by their lithological character, and which lack primary stratification. This report sets out proposals for classifying and naming all types of lithodemic unit other than intrusions. The units are organised in two hierarchical chains referred to as *tectonometamorphic units* and *mixed-class units*. These proposals complete a comprehensive BGS scheme for classifying and naming lithostratigraphical and lithodemic units, which is presented here in four hierarchical chains spanning up to seven ranks (Table 1). Within the scheme, the seven established types of *lithostratigraphical unit* (NACSN, 1983; Rawson et al., 2002), thirty-four types of *intrusive unit* (Gillespie et al., 2008), and twelve types of *tectonometamorphic unit* (this report) are placed in parallel parent–child chains that straddle the same six ranks (Rank 1 to Rank 6). Each of these three hierarchical chains represents a distinct class of mappable unit. Within each chain, parent units embrace children of the same class (i.e. at lower ranks in the same chain), so the units in each of these three hierarchies are referred to as ‘single-class units’. In the fourth chain (this report), parent units embrace children from two or more of the three hierarchies of single-class units, so the seven types (and four ‘special cases’) of lithodemic unit within it are referred to as *mixed-class units*. At present, the units in this chain straddle five ranks, one of which is not shared by any of the other chains; additional types of *mixed-class unit* may be inserted in other ranks of this chain if a need is demonstrated when the scheme is used to classify mapped units. Guidance is given for assigning formal names to *tectonometamorphic* and *mixed-class units*. Completion of the scheme means it is now possible to classify and name lithostratigraphical and lithodemic units, separately and in any combination, in any setting, in a systematic and rigorous manner. The general principles of the classification and its associated terminology should apply anywhere in the world.

Worked examples span a range of the geological scenarios that may be encountered worldwide, and illustrate how mapped units in various settings and combinations can be classified and named using the proposals set out here.

A glossary of the terms proposed here for tectonometamorphic and mixed-class units, and of other terms relevant to these proposals, forms an important part of this document.

Feedback is encouraged ([agle@bgs.ac.uk](mailto:agle@bgs.ac.uk)).

# 1 Introduction

The units of rock shown on geological maps can be distinguished and delimited in various ways, for example by lithological character (lithostratigraphical units and lithodemic units), by fossil content (biostratigraphical units), and by age (chronostratigraphical and geochronological units). Lithostratigraphical and lithodemic units are the most widely used in geological mapping, and they form the basis of British Geological Survey maps and digital geological models. The term *lithostratigraphical* encompasses stratified sedimentary, volcanic and volcanoclastic units (and their metamorphosed equivalents), i.e. they conform with the Law of Superposition (North American Commission on Stratigraphic Nomenclature [NACSN], 1983, 2005; Rawson et al., 2002). The order thus deduced may be substantiated by evidence of depositional way-up or other criteria for succession. The term *lithodemic* refers to units that generally lack primary stratification (i.e. they do not conform with the Law of Superposition). Many lithodemic units consist predominantly of intrusive, highly deformed, and/or highly metamorphosed rock. Mixtures of intrusive, highly deformed, metamorphosed and/or lithostratigraphical units can and do occur within discrete mappable units. Those displaying an essentially mixed character are referred to hereafter as ‘mixed-class units’.

A well-established and internationally recognised scheme in which lithostratigraphical units are classified in six ranks has been used by BGS to create formal classifications of onshore lithostratigraphical units in the UK, (in hierarchical order bed/flow–member–formation–subgroup–group–supergroup; NACSN, 1983; Rawson et al., 2002). These classifications are presented in the BGS Stratigraphical Framework report series, and are now accepted widely and used on all modern BGS maps, and in BGS publications, databases and associated digital products. The need for a formal BGS classification of lithodemic units of the UK has been demonstrated during the recent development of major projects such as the *Lexicon of Named Rock Units*, the *Digital Geological Map of Great Britain (DiGMapGB)*, production of the latest *1:625,000 scale map of the UK* (British Geological Survey, 2008a, b), and the *Stratigraphical Chart of the United Kingdom* (Waters et al., 2007).

A simple scheme for classifying lithodemic units was proposed by the NACSN in association with their more detailed proposals for classifying lithostratigraphical units (NACSN, 1983). In that scheme, units of one class (e.g. intrusive units) are classified in a simple hierarchical chain of three ranks (lithodeme–suite–supersuite), while mixed-class units are classified in a separate chain of three ranks (subcomplex–complex–supercomplex). However, the scheme lacks the breadth and flexibility required to deal with the wide range of lithodemic and mixed-class units represented in the UK, and the UK geological community has not adopted it widely. BGS has therefore taken on the task of developing a scheme for classifying and naming lithodemic units of the UK which will complement the well-established scheme for lithostratigraphical units. Proposals for a BGS scheme to classify intrusive units have been published recently (Gillespie et al., 2008). This new report sets out proposals for classifying and naming the other (nonintrusive) types of lithodemic unit, which are represented here in two hierarchical chains referred to as *tectonometamorphic units* and *mixed-class units*. These additions complete a comprehensive BGS classification of all lithostratigraphical and lithodemic units.

The main purpose of the scheme is twofold: to assist the systematic generation of maps, models and databases; and to promote widespread use within the UK of a consistent nomenclature and classification hierarchy for mapped rock units, thereby assisting in communicating and documenting UK geological history. The general principles of the classification and its associated terminology should apply to mappable units anywhere in the world and hence should be followed, where appropriate, by BGS teams working in any locality and context. The scheme will, over time, be presented to a wider national and international audience (e.g. through BGS publications, collaborations and the BGS website), and it, or a derivative from it, may eventually

attain general and widespread usage. It must therefore be sufficiently flexible that necessary amendments to the classification scheme can be implemented readily at a later date.

Every effort has been made to provide recommendations for best practice and to keep the scheme as simple as possible. That said, the lithostratigraphical and intrusive igneous classifications arguably deal with more straightforward units that have not been significantly modified from their geological origins; these tectonometamorphic and mixed-class units present a number of challenges to a simple yet robust classification scheme. As with all attempts to classify natural systems there is no unique solution. The robustness of the recommendations set out here will be tested thoroughly only when the full classification is ‘used in anger’ and it may be necessary at that stage to alter some aspects of the scheme. Feedback is encouraged ([agle@bgs.ac.uk](mailto:agle@bgs.ac.uk)). Note that the examples provided in section 4 are designed to illustrate the proposals set out in this report and are not intended as formal entries to the BGS Lexicon.

A glossary of the terms proposed here for tectonometamorphic and mixed-class units, and of other terms relevant to these proposals, forms an important part of this document. Several key terms are defined in the following text, but readers should refer to the glossary to find formal definitions for approved terms.

## 2 Proposals

Table 1 presents the proposed BGS classification of lithostratigraphical and lithodemic units. The diagram unites four hierarchical chains, which are colour coded for clarity. The seven established types of lithostratigraphical unit are linked in a parent–child chain straddling six ranks (NACSN, 1983; Rawson et al., 2002). Thirty-four types of intrusive unit (Gillespie et al., 2008) and twelve types of tectonometamorphic unit (this report) are placed in parallel parent–child chains that straddle the same six ranks. Each of these three hierarchical chains represents a distinct class of mappable unit. Within each chain, parent units embrace children of the same class (i.e. at lower ranks in the same chain), so the lithostratigraphical and lithodemic units within these three hierarchies are referred to as ‘single-class units’. In the fourth chain, parent units embrace children from two or more of the other hierarchies, so the seven types (and four special cases) of lithodemic unit within it are referred to as ‘mixed-class units’ (this report). At present, the units in this chain straddle five ranks, one of which (‘Rank 0’) is not shared by any of the other chains. Rank 6 is taken to be the ‘lowest’.

### 2.1 SINGLE-CLASS UNITS

Virtually all the geological material in the Earth’s crust is part of, or was originally part of, a depositional unit or an intrusion. The great majority of discrete mappable units in the UK retain enough information regarding their original character and setting to be classified readily as either lithostratigraphical units or intrusive units, regardless of subsequent modification by metamorphic or tectonic processes. In these cases, it is possible to create parent–child classifications using only one hierarchical chain, i.e. using only single-class units. The hierarchies for lithostratigraphical units and intrusive units set out in Table 1 are, therefore, widely applicable to mappable units encountered in the UK; the details of these hierarchies are not described here, but are set out in the publications cited above.

Tectonometamorphic units are mappable units that cannot be classified as, or linked to, lithostratigraphical units or intrusive units. This will generally be because their original character and/or setting have been modified substantially by deformation and/or metamorphism, resulting in a significant degree of uncertainty concerning their full geological interpretation. It will be the responsibility of the geological mapper/compiler to decide which hierarchical chain to use when

classifying a thoroughly deformed and/or metamorphosed unit. An example of strongly deformed metasedimentary units is described in section 4.1, (Table 2).

### 2.1.1 Classifying tectonometamorphic units

Tectonometamorphic units are classified in a hierarchical chain with six formal ranks (Table 1), in a manner that is broadly similar to that used for the two other hierarchies of single-class units. Two distinct categories of tectonometamorphic unit are recognised and defined below:

- Metamorphosed units have been metamorphosed (and commonly deformed) to an extent that the origin of the protolith (depositional unit or intrusion) cannot be deduced or inferred reliably, and/or the boundary(ies) of the unit(s) has(ve) been modified such that the nature of the original relationship with adjacent units (unconformable/depositional/intrusive) cannot be determined reliably. High-grade gneiss ‘terranes’, such as the Lewisian rocks of north-west Scotland (see section 4.4), generally consist largely or entirely of metamorphosed units. Metamorphosed units are therefore probably the category of tectonometamorphic unit of greatest global areal extent. Note however that many deformed and metamorphosed sequences can be robustly classified in lithostratigraphical terms, e.g. the Dalradian Supergroup.
- Isolated units have become physically separated from their original stratigraphical or intrusive context such that they cannot now be classified reliably within an existing hierarchical framework for lithostratigraphical or intrusive units. To follow the parent–child philosophy, such units could be thought of as ‘orphaned’. Isolated units can form in a variety of ways and in a range of settings, as illustrated by the following examples: an allochthonous unit in a thrust zone that cannot be related reliably to any autochthonous unit in the footwall or hanging wall; unit(s) forming an ‘island’ that cannot be related reliably to any formally classified lithostratigraphical or intrusive unit; the new mappable unit(s) formed in a shear zone through intense tectonic interleaving of material derived from the units juxtaposed across the shear zone.

An isolated unit may contain more than one mappable entity. These must also be ‘isolated’ in the sense employed here, and must therefore be classified as tectonometamorphic units, even though the mapped entities may form a lithostratigraphical succession within the confines of the isolated unit. Multiple isolated units can be classified in a parent–child chain within the hierarchy for tectonometamorphic units if they are deemed to be related; for example, two allochthonous units of limestone in the same thrust zone that cannot be related reliably to a formally classified autochthonous limestone unit could be united as a unit of higher rank in the tectonometamorphic hierarchical chain.

Some units can have the character of either or both of these categories; a metamorphosed unit can also be an isolated unit. Neither term is a requirement for formal classification of a tectonometamorphic unit and thus does not appear in Table 1.

Classification in the lower ranks (6, 5 and 4) of the hierarchy for tectonometamorphic units depends on the shape of individual units and the nature of their spatial association, as follows.

- Four types of tectonometamorphic unit are classified at Rank 6: *block*, *lens*, *layer* and *mass*. *Lens* and *layer* denote the 3D shape of a unit (observed or inferred), *block* denotes a unit with rectilinear boundaries, and *mass* denotes a unit whose character is not well described by any of these terms, or is unknown.
- Two or more units classified at Rank 6 may be united within one of three parent units at Rank 5 according to the nature of their spatial association: *train* and *swarm* denote

spatially dispersed associations, the former in a broadly linear arrangement, whereas *parcel* denotes a spatially coincident (largely contiguous) association.

The term ‘swarm’ also appears in Rank 5 of the intrusive units hierarchy, although there it is always linked to a Rank 6 term to make compound terms like *dyke-swarm* and *sill-swarm* (Table 1). Its use here, to denote two or more tectonometamorphic units that display a natural association but are spatially dispersed, reflects the absence of a better alternative term to fulfil this role. Terms from Rank 6 of the tectonometamorphic hierarchy can, if appropriate, be linked to ‘swarm’ to make compound terms like *block-train* and *layer-swarm*. The term can also be used on its own in formal names, but where necessary its tectonometamorphic (not intrusive) context must be made clear, for example in any accompanying description. Similarly, the context must be clear in any informal (generic) use of the term (e.g. ‘... the shear zone includes a swarm of km-scale serpentinite blocks ...’).

- Two or more units classified at Rank 6 and/or 5 may be united within one of two parent units at Rank 4: *set* denotes a spatially dispersed (i.e. noncontiguous) association, whereas *package* denotes a spatially coincident (largely contiguous) association.

For the higher ranks of the hierarchy (3, 2 and 1), two or more tectonometamorphic units classified at Rank 6 and/or 5 and/or 4 can be united at Rank 2 in an *assemblage*. A subset of the units within an *assemblage* that display a natural association can be united at Rank 3 in a *subassemblage*. Two or more tectonometamorphic units of Rank 2 or lower can be united at Rank 1 in a *superassemblage*.

In practice, there are likely to be few examples of associations of isolated or metamorphosed tectonometamorphic units that require more than three ranks (typically 6, 5 and 4) of classification. More usually, they will be united at higher ranks with units of another class to create mixed-class units (see below).

### 2.1.2 Naming tectonometamorphic units

The convention proposed for naming tectonometamorphic units follows that established for intrusions (Gillespie et al., 2008). Units classified in ranks 6 and 5 should be assigned a tripartite name consisting of a geographical component, a lithological component, and a lithodemic component; for example *An Cnoc Quartzite Lens*, *Newtown Harzburgite Layer*, *Glen Trail Amphibolite Train*, and *Glen Ordie Metasedimentary Parcel*.

Units classified in ranks 4 to 1 can be assigned a bipartite name consisting of a geographical component and a lithodemic component; for example *Menai Assemblage*. A lithological component can be included (in between the geographical and lithodemic terms, as above), if deemed appropriate; for example *Someplace Limestone Set*, *Fannich Metasedimentary Superassemblage*. In exceptional cases, usually because of strong historical precedent, conventional naming protocols may be relaxed. Precedent may also apply to the lithological component, where for strong historical reasons nonstandard names may be used, e.g. Oystershell Rock (see section 4.2).

## 2.2 SINGLE-CLASS UNITS THAT INCLUDE MINOR COMPONENTS OF ANOTHER CLASS

Geological rock units commonly resist simple classification, and geologists will in many cases need to use common sense and pragmatism in deciding how best to classify mapped units. In general, the way in which units are classified and named should critically reflect and convey their essential character. For example, not all of the units grouped within a *package* need be contiguous, but the essential character of a *package* should be of largely contiguous units.

Similarly, a body of granite can enclose one or many mappable xenoliths of sedimentary rock and still be classified as a *pluton* (rather than a mixed-class unit) if its essential character remains that of an intrusion.

Pragmatic solutions will in some instances require the creation of nonstandard parent–child relationships. For example, within a metamorphosed depositional sequence that can still generally be mapped and classified according to lithostratigraphical principles, locally intense metamorphism may create a new mappable unit of migmatitic and/or gneissose rock that clearly has a sedimentary protolith but within which the limits of the original depositional unit(s) can no longer be recognised and delimited with confidence. The Moine and Dalradian supergroups of the Scottish Highlands both contain good examples of such occurrences. These regional-scale units were created as depositional sequences, however metamorphism and melting have locally created within them new lithodemic units (tectonometamorphic units and intrusions) of gneiss, migmatite and granite. Though such occurrences mean that the Moine and Dalradian units could be said to consist of mixtures of two or more classes of unit, it would be unhelpful and inappropriate to classify either of them as a mixed-class unit *sensu stricto* because the proportion of lithodemic units is very small and does not change the essential character of the parent unit. It would also be unhelpful to classify the lithodemic units formed within, and from, the lithostratigraphical units in a separate parent–child chain, as this might suggest they are entirely unrelated. The pragmatic solution in this instance would be to classify the main unit (i.e. the Moine or Dalradian host) according to its essential (lithostratigraphical) character and include within its parent–child chain some non-lithostratigraphical units. These may be thought of as 'stepchildren' to lithostratigraphical parents. Thus, a mapped unit of gneissose rock lacking depositional boundaries but clearly formed from, and situated within, the *Dalradian Supergroup* could be classified and named as a tectonometamorphic unit (e.g. *Duchray Hill Gneiss Mass*) and placed in the parent–child hierarchy of the *Dalradian Supergroup* as a (step)child of the host *formation*.

Where anatexis has produced concordant sheets of igneous rock within an essentially lithostratigraphical sequence there is a dilemma. In such a setting, mapped units consisting mainly or entirely of igneous rock may lack intrusive boundaries and will have formed more-or-less *in situ* from a depositional protolith. How best to classify such units will depend on a number of factors, including their size, number, the extent to which they incorporate relics of the protolith, and the way they have been treated historically. Larger and/or more numerous occurrences of anatectic sheets are probably best classified within the hierarchy for intrusive units (e.g. as a number of *sheets*, *laccoliths*, or *lopoliths*). Those still associated intimately with a significant proportion of *in-situ* country rock may be better classified within the lithostratigraphical hierarchy and named accordingly. The *Badanloch Granite Sheet-swarm* could be an example of an anatectic intrusive stepchild, ultimately hosted by a lithostratigraphical parent, the *Moine Supergroup* – see section 4.3.

## 2.3 MIXED-CLASS UNITS

A mappable unit comprising a significant proportion of each of two or more classes of single-class unit, such that its *essential character* is 'mixed', should be classified as a mixed-class unit. All mixed-class units must, by definition, consist of more than one mapped unit, so Rank 6 of the hierarchy (reserved for single mapped units) is not used (Table 1). By similar reasoning, there is also a hierarchical requirement for a rank above Rank 1 for mixed-class units where two Rank 1 units are combined; hence 'Rank 0' is included in the classification of Table 1 (see also section 4.5). Rank 5 is currently unused, though this may change if a need is demonstrated when these proposals are used to create formal classifications of mixed-class units.

Single-class units classified within the hierarchies for lithostratigraphical or intrusive units (up to and including Rank 1) can be incorporated within a mixed-class unit, as long as the units

concerned are contained wholly within the mapped extent of the mixed-class unit. For example, units of the *Scourie Dyke Suite* crop out only within the extent of the *Lewisian Supercomplex*, and can therefore be incorporated within (i.e. as a child of) this mixed-class unit, whereas Palaeogene dykes crop out within and outwith the extent of the *Lewisian Supercomplex* and therefore cannot be a lithodemic child of it. This convention avoids the problem of units having two parents.

### 2.3.1 Classifying mixed-class units

The main hierarchical chain for mixed-class units is *subcomplex–complex–supercomplex–megacomplex* (Table 1, in bold text). *Complex* occupies the same rank as the single-class units *group*, *suite*, and *assemblage*. As in the hierarchies for single-class units, a unit must be classified at Rank 2 (in this case *complex*) before a ‘*sub*’ child (in this case *subcomplex*) can be classified at Rank 3. Two mixed-class units occupy separate ranks above *complex*: *supercomplex* at Rank 1, and *megacomplex*. The highest ranking mixed-class unit must be capable of being a parent to the highest rank of single-class units, so a new ‘Rank 0’ is created for the mixed-class unit *megacomplex*. *Complexes*, *supercomplexes* and *megacomplexes* can unite two or more mixed-class units, or two or more different classes of single-class units, or a mixture of mixed-class units and single-class units, provided they are of lower rank and display a natural association.

Several types of mixed-class unit are included in Table 1 (in plain text) for the reason that their names are already widely used in publications. *Ring-complex*, *sheet-complex*, *sill-complex*, *vein-complex*, *central complex*, and *volcano-complex*, are all included and labelled ‘Special cases’ on Table 1. A map polygon encompassing a *sill-swarm* (intrusive unit) and the sedimentary rocks of a *member* (lithostratigraphical unit) into which the *sill-swarm* is emplaced could be classified as a *sill-complex*, at Rank 4. Formal definitions of the terms for these Rank 4 mixed-class units that typically consist dominantly of intrusive rock are given in Gillespie et al. (2008).

The mixed-class unit *ophiolite*, at Rank 3 (Table 1), can be used to identify and unite an oceanic crust association. This is traditionally recognised as several layers of ultrabasic and basic igneous rock, *dykes* and other intrusions, pillow lavas and sea-floor sediments. Not all of these components need be present to classify a unit as *ophiolite*, but the geologist must be satisfied there is enough evidence to support an interpretation that the units in question represent former oceanic crust.

*Ophiolite* and single-class units (e.g. intrusions and/or depositional units) that are assembled tectonically during obduction, or other superimposed tectonism, may be classified as an *ophiolite complex*, at Rank 2. Qualification of *complex* in this manner (without use of a hyphen) reflects common use in the geological literature; other similar examples may emerge as the classification becomes used widely. An example classification and nomenclature for the *Shetland Ophiolite Complex* is presented in section 4.6 and Table 7.

### 2.3.2 Naming mixed-class units

Formal names for mixed-class units should consist of a geographical component and a lithodemic component; for example *Highland Border Complex*, *Lewisian Supercomplex*, and *Anglesey Megacomplex*.

## 3 Additional considerations

### 3.1 ENTRY POINTS TO THE CLASSIFICATION HIERARCHIES

In lithostratigraphy there is a ‘fundamental unit’, the *formation* (Rank 4), which must be identified first in classification, i.e. Rank 4 is the ‘entry point’ to the hierarchy for lithostratigraphical units (Rawson et al., 2002). Units classified at lower and higher ranks of the hierarchy are created by subdividing or uniting *formations*.

The hierarchy for intrusive units has no equivalent ‘fundamental unit’. Classification should in general begin with single mappable units (i.e. the entry point is Rank 6 or 5), which are then united to create units in progressively higher ranks (Gillespie et al. 2008).

Tectonometamorphic units and mixed-class units are likely to be important in geologically complicated settings, in projects requiring rapid mapping of large areas, and in preliminary/reconnaissance surveys of new or little-known areas. It is therefore impracticable to designate a ‘fundamental unit’, and in many cases it will be impracticable to start the classification process with units in the lowest rank. The ‘entry point’ for classifying tectonometamorphic units and mixed-class units is therefore not prescribed, but is left to the geologist’s discretion. In many instances it may be advantageous to begin the process of classification by identifying units at a middle rank (e.g. *package*, *assemblage*, *complex*), then, if time and knowledge permit, work to divide these into lower-ranking units, and/or unite them in higher-ranking units. Where this approach is used, early designations will be prone to change, hence classification and nomenclature should be considered informal until all the mappable (or mapped) units are classified and the classification is shown to work at all the occupied ranks. In practice the starting point for a regional mapping project may be satellite imagery or high resolution airborne geophysics which should allow the geologist to establish the main mapping units at a relatively high rank such as *complex* (Rank 2), subsequent ground-truthing will then identify the sustainable lower rank units.

### 3.2 REVISING CLASSIFICATIONS WHEN NEW INFORMATION PERMITS

Mapped units should wherever possible be classified as lithostratigraphical units or intrusive units, even if strongly modified by deformation or metamorphism (see section 4.1). To comply with this principle, tectonometamorphic units and mixed-class units may be reclassified and renamed as lithostratigraphical units or intrusive units when new information sheds light on original depositional or intrusive relationships. Over time, this process could result in some established names for units becoming diminished in importance or becoming obsolete. For example, a tectono-metamorphic *package* or *assemblage* might be reclassified as a *formation* or *group* respectively when new research establishes reliable evidence of an originally stratiform character. An example is given in section 4.7 and Table 8 of one such revision debated in the literature (Tanner and Sutherland, 2007).

### 3.3 LITHODEMIC CLASSIFICATION AND TERRANE ANALYSIS

This scheme should not be confused with terrane nomenclature or used directly in terrane analysis, even where a terrane fulfils the criteria for a mixed-class unit. Although there may indeed be cases where the extent of a *complex*, *supercomplex* or *supergroup* coincides wholly with a terrane, lithostratigraphical and/or lithodemic units may occur in more than one terrane. Indeed, a boundary between two *complexes* may be tectonic, intrusive or unconformable, but only in the first case could it qualify as a terrane boundary (e.g. Coney, 1980).

## 4 Example applications of the proposed scheme

This section explores a variety of geological scenarios in terms of their increasing complexity within the context of the proposed scheme. The examples chosen illustrate particular aspects of the scheme; some units are omitted from the discussion for clarity. **We stress that the examples are presented here only to illustrate the proposed hierarchy of lithodemic units and the convention for naming them; the inclusion of previously unused names is not a formal proposal to change the BGS Lexicon.** Where Lexicon codes are shown, the reader will find the code and unit in the BGS Lexicon, though the stated lithodemic classification may differ from that implied in the example in this report. Where the term ‘Someplace’ is used here in a name, a recognised geographical name would be substituted in due course, should the unit achieve formal recognition. The term ‘unnamed’ is used only in Rank 6 and implies that no formal name needs to be introduced.

### 4.1 CLASSIFYING STRONGLY DEFORMED METASEDIMENTARY UNITS: THE DAVA AND GLEN BANCHOR GROUPS, NORTHERN GRAMPIAN HIGHLANDS OF SCOTLAND

Interlayered and polydeformed units of metamudstone and metasandstone underlie parts of the Northern Highlands and Grampian Highlands of Scotland, and present a good example of a situation where designation as lithostratigraphical units requires careful consideration. Table 2 illustrates how the proposed classification of such units would work for the present Dava/Glen Banchor Succession of the northern Grampian Highlands of Scotland (British Geological Survey, 2004; Smith et al., 1999), previously referred to as the Central Highlands Division (Piasecki and van Breemen, 1979). These units are typically complexly folded; original depositional boundaries and way-up criteria cannot be identified. However, they are clearly sedimentary in origin and have been mapped by means of identifying units on the basis of lithological change, i.e. stratal layering can be identified at the outcrop scale. The units are thus understood to have conformed with the Law of Superposition and should be classified as lithostratigraphical units in the proposed scheme (see Table 2).

### 4.2 CLASSIFYING TECTONOMETAMORPHIC UNITS: THE MOINE THRUST MYLONITE SET, NORTH-WEST SCOTLAND

Mylonitic rocks within the Moine Thrust Zone of north-west Scotland provide a good example of metamorphosed units in which any primary stratigraphical or intrusive relationships have been obscured by deformation, such that the units cannot be correlated readily with any formally classified units outwith the deformation zone.

The mylonites are derived from quartzite, carbonate-rock and gneiss, and include the enigmatic ‘Oystershell Rock’ (e.g. Peach et al., 1907; Holdsworth et al., 2001; British Geological Survey, 2002, 2007). Whilst it is reasonable to assume on the basis of composition that the units of quartzitic mylonite are derived from the *Eriboll Sandstone Formation*, it is not possible to link them to individual members in that formation (*Basal Quartzite Member* and *Pipe Rock Member*). That being the case, mapped units of quartzitic mylonite cannot be correlated *directly* and hence should be classified as tectonometamorphic units. Intense deformation is key to the essential character of these units. The Oystershell Rock is a phyllonitic unit whose protolith has remained unidentified for more than a century. Although most geologists now agree the pre-mylonitic rock was quartzo-feldspathic gneiss, it is still debatable whether this was part of the *Lewisian*

*Supercomplex* of the Caledonian foreland or the *Lewisianoid Gneiss Complex* associated with Moine Supergroup rocks in the east.

In this example (Table 3), two or more unnamed metamorphosed units of mylonitic rock are classified as *layers* at Rank 6 and united within four named *parcels* at Rank 5 according to their lithological character. These are in turn united at Rank 4 in the *Moine Thrust Mylonite Set*, (formerly the *Moine Thrust Mylonite Complex*). The lithodemic unit *set* is preferred to *package* because the map polygons occur intermittently as thin slivers within a 200 km long zone, parallel to the Moine Thrust (i.e. they are dispersed rather than contiguous).

#### **4.3 CLASSIFYING SINGLE-CLASS UNITS THAT INCLUDE MINOR COMPONENTS OF ANOTHER CLASS: THE MOINE SUPERGROUP OF THE NORTHERN HIGHLANDS OF SCOTLAND**

The *Moine Supergroup* is a thick and aerially extensive sequence of Neoproterozoic siliclastic metasediments in the Northern Highlands. The original sedimentary rocks have been deformed and metamorphosed to amphibolite facies during several orogenic phases, and commonly display evidence of polyphase tectonic deformation. Ductile thrusts and shear zones disrupt the sequence. Nevertheless, sedimentary structures are preserved locally and a lithostratigraphy has been constructed (Johnstone et al., 1969; Roberts et al., 1987; Holdsworth et al., 1994; Strachan et al., 2002). The *Moine Supergroup* encompasses the *Morar*, *Glenfinnan* and *Loch Eil groups*, each comprising several *formations*. The relationship between the *Glenfinnan* and *Loch Eil groups* is demonstrably stratigraphical (Roberts et al., 1987). The relationship between the *Morar* and *Glenfinnan groups* is less clear, but does not warrant a non-lithostratigraphical designation (Holdsworth et al., 1987). The *Morar Group* also has an unconformable depositional relationship with its basement. A large part of the Moine rocks can therefore be classified as lithostratigraphical units (Table 4).

In north-east Sutherland the Moine rock units are strongly metamorphosed and commonly consist of migmatitic gneiss. Sedimentary structures and stratal boundaries are obliterated such that these units have become good examples of tectonometamorphic units. Accordingly, they have been classified as such in Table 4 (shown in green), using terms from the tectonometamorphic units hierarchy (e.g. *Bettyhill Gneiss Package* – currently *Bettyhill Gneiss Formation*). The lithostratigraphical parent of these units at Rank 2 (i.e. *Morar*, *Glenfinnan* or *Loch Eil group*) is also uncertain. Consequently, on Table 4 the units have been united within a new tectonometamorphic unit at Rank 2, the *Sutherland Assemblage*. There is no doubt however that the *Sutherland Assemblage* is part of the *Moine Supergroup*. Thus, when considered as a whole, the essential character of the parent unit (*Moine Supergroup*) is lithostratigraphical, hence it retains its lithostratigraphical name.

Some units in the far south-east of Sutherland are stratiform, obey the Law of Superposition, and can therefore be classified and named lithostratigraphically (e.g. *Kildonan Psammite Formation*, *Scaraben Quartzite Formation*). These could be linked to higher-rank units in the hierarchy in several ways, and the geologist must choose the most appropriate: (i) they could be assigned to the *Loch Eil Group* (but there is a rather large spatial ‘gap’ between them and definite *Loch Eil Group* rocks to the south); (ii) they could be united with adjacent tectonometamorphic units in the *Sutherland Assemblage* (as shown in Table 4); or (iii) they could have the *Moine Supergroup* as their immediate parent. Regardless of which of these is chosen, they could additionally be united at Rank 3 (within a *subassemblage* or *subgroup*) to highlight their shared character.

The *Badanloch Granite Sheet-swarm* is a series of granite sheets that represent partial melts derived from the *Loch Coire Migmatite Package* and the *Kildonan Psammite Formation*. Since the granite sheets are confined to these units and are clearly derived from them, the *Badanloch*

*Granite Sheet-swarm* could be an example of an ‘intrusive’ unit classified as a stepchild of a lithostratigraphical unit (*Moine Supergroup*).

The *Strathy Gneiss Package* comprises orthogneisses and metasedimentary rocks that are in part paragneisses. However, these rocks are probably substantially older than the *Moine Supergroup* and cannot be part of that unit. At the present state of knowledge this is a good example of an isolated unit.

The siliclastic rocks of the *Tarskavaig Group* in south-western Skye cannot, at present, be correlated reliably with the *Moine Supergroup* east of the Moine Thrust, or with the *Sleat Group* or *Torridon Group* of the Caledonian Foreland. At present, the *Tarskavaig Group* embraces only a single formation, the *Aruisg Psammite Formation*. This situation is not desirable, as a group should comprise two or more formations. It might be advisable to redefine this unit as an isolated unit, and reclassify it accordingly, for example *Tarskavaig Psammite Package*, losing group status.

#### 4.4 CLASSIFYING MIXED-CLASS UNITS: THE LEWISIAN SUPERCOMPLEX, NORTH-WEST SCOTLAND

The *Lewisian Gneiss Complex* of north-west Scotland is well exposed and well studied (e.g. Park, 2002, Park et al., 2002, Mendum, in prep.), and a terrane-based nomenclature has been proposed recently (Kinny et al., 2005). This provides a good starting point for discussion, though it is important that the terrane nomenclature of Kinny et al. (2005) is not confused with the lithodemic classification described here (see section 3.3). The example shown in Table 5 covers only the north and central parts of the mainland outcrop of the *Lewisian Gneiss Complex*, as this is sufficient to illustrate the principles of the proposed hierarchical classification. The complexity of the unit necessitates ‘upgrading’ the present *Lewisian Gneiss Complex* to *supercomplex* status: thus the *Lewisian Supercomplex*.

Table 5 illustrates how the proposed classification of high-grade gneiss units could work:

- Most of the area comprises orthogneiss, which can locally be subdivided on lithological grounds (according to specific rock type, e.g. metagabbro, or broad character, e.g. mafic, or felsic gneiss), or on the basis of metamorphic grade. Individual mapped polygons of a specific lithology could be classified at Rank 6 (e.g. the *unnamed mafic orthogneiss mass*), and two or more Rank 6 units could be united at Rank 5 (e.g. the *Someplace Felsic Orthogneiss Parcel*). Low-ranking units displaying a natural association could be united at Rank 4 in a *package* (e.g. the *Someplace Gneiss Package*) if they are essentially contiguous, or in a *set* (e.g. the *Ullapool Gneiss Set*) if they are dispersed.
- Numerous bodies of deformed meta-igneous rocks that lack preserved original intrusive boundaries (mainly metagabbro; not gneiss *sensu stricto*) occur locally within the gneisses. Individual bodies could be assigned to Rank 6 and given a name appropriate to their shape (e.g. *Ben Strome Metagabbro Mass*). A number of bodies with similar lithology could be grouped as a *swarm* or *train* (e.g. the *Cnoc Gorm Metagabbro Swarm*) at Rank 5. Note that it not relevant here whether the individual units were intruded separately or originally formed a single intrusive body that was subsequently ripped apart by tectonic processes.
- A sizeable association of metasedimentary and meta-igneous rocks known as the *Loch Maree Group* (Park, 2002) comprises layers of semipelitic schist, marble, and ironstone alternating with layers of amphibolite. The layers are intensely folded and no sequence can be established reliably. The nature of the amphibolite protolith (extrusive or

intrusive) is uncertain, hence they are treated here as metamorphosed units (section 2.1.1). The *Loch Maree Group* could be considered as a tectonometamorphic unit, and reclassified (as shown in Table 5) as a number of *layers* or *parcels* (e.g. the *Flowerdale Marble Layer* or *Kerrysdale Amphibolite Parcel*) that are united within a *Loch Maree Assemblage* (or *Loch Maree Package*). The *Ard Granite Gneiss Parcel* is undoubtedly meta-igneous but is nevertheless associated intimately with the paragneisses of the *Loch Maree Assemblage*. Further, after careful consideration, the geologist could therefore propose that the former *Loch Maree Group* has the essential character of a mixed-class unit and be reclassified as the *Loch Maree Complex*.

- A large number of Palaeoproterozoic mafic and ultramafic dykes, the *Scourie Dyke Suite*, intrude gneisses of the *Lewisian Supercomplex*. All the dykes are metamorphosed to a degree; however, they still generally have intrusive boundaries and can be classified as intrusions. The *suite* embraces four *dyke-swarms* (e.g. the *Beannach Metapicrite Dyke-swarm*), which are distinguished on the basis of lithology (Tarney and Weaver, 1987; British Geological Survey, 2007). The *Scourie Dyke Suite* is classified as a child of the *Lewisian Supercomplex* because it crops out wholly within the areal extent of the *supercomplex*. Later deformation has locally incorporated many of the dykes into the host gneisses, making them difficult to distinguish from earlier (Archaean) mafic gneisses

#### 4.5 CLASSIFYING MIXED-CLASS UNITS: THE ANGLESEY MEGACOMPLEX, NORTH-WEST WALES

The Neoproterozoic to Cambrian rocks of Anglesey provide a good example of a highly complicated association of lithostratigraphical, intrusive, and tectonometamorphic units that present a good test of the proposed hierarchy for mixed-class units. However, the complexity of the area means that stratigraphical/structural relationships, and the definitions of the different units, are in many cases ambiguous, and a number of different interpretations and classifications exist in the recent literature (Phillips, 1991, Gibbons and Ball, 1991; Gibbons et al., 1994). No modern BGS maps exist for most of the area, and several current Lexicon codes are inappropriate.

Rock units are commonly separated by faults or shear zones and have been assigned to several terranes: the Coedana Terrane, Aethwy Terrane, and Monian Supergroup Terrane together comprise the Monian Composite Terrane (e.g. Gibbons, 1989, Pharaoh and Carney, 2000, McIlroy and Horák, 2006). However, the terrane interpretation has recently been challenged by Kawai et al. (2007). Lithodemic classification should be independent of terrane analysis (see section 3.3), but the two should not contradict each other.

Table 6 illustrates how a reclassification of the mapped units of Anglesey might work.

1. The lower part of the *Monian Supergroup* has a reasonably well established lithostratigraphy, comprising the *Holy Island Group* and the *New Harbour Group*, each embracing two or more *formations* (e.g. Phillips, 1991; Gibbons et al., 1994). The *Skerries Grits* and *Church Bay Tuffs* could be assigned *member* status and together form the *Skerries Formation* (but see point 8, below), within the *New Harbour Group*, following Phillips (1991). Note that in the BGS Lexicon, the latter units are assigned to the ‘Gwna Group’, which is not appropriate.
2. Within the turbiditic *New Harbour Group* (undivided on Holy Island) there are mappable units of serpentinite and metagabbro. These have nonintrusive boundaries and are probably megaclasts slumped downslope during turbidite deposition (Phillips, 1991). As such they

- are isolated units and could be reclassified individually as *blocks* (Rank 6), and collectively as, for example, the *Cae'r Sais Serpentinite Swarm*. As indicated in section 2.2, it is permissible for tectonometamorphic units to have a parent lithostratigraphical unit (e.g. a *formation* or *group*), provided the essential character of the latter remains lithostratigraphical.
3. The Gwna Melange, commonly placed within the 'Gwna Group', is a more complicated matter, with the nature of boundaries (tectonic, intrusive or depositional) uncertain. The melange is described as a 300 m thick chaotic unit with mappable 'clasts' or 'blocks' of limestone, quartzite, granite and metabasalt now set in a matrix of pelitic and semipelitic schist. The blocks are highly disrupted and cannot be classified lithostratigraphically.
    - a) Where they are mapped as individual polygons, each 'clast' could be classified as a *block* or *mass*, according to its shape. Two or more *blocks* of similar lithology could be united within a *swarm* or *train*, for example the *Bardsey Island Granite Block-swarm*.
    - b) The status of the 'Fydlyn Felsitic Beds' and the Gwyddel Felsitic Formation has changed. Some authors considered these stratigraphically to overlie the Gwna Melange (e.g. Shackleton, 1975). However, Gibbons and Ball (1991) and Gibbons and McCarroll (1993) demonstrated that these 'beds' are in fact megaclasts within the Gwna Melange. Assuming that is the case, they are not 'beds' in the lithostratigraphical sense and would be reclassified as tectonometamorphic units of Rank 6, renamed accordingly, and united with other single mapped units classified at Rank 6 to form, for example, the *Gwyddel Chert Block-swarm* at Rank 5.
    - c) Similarly, it is unlikely that the Tyfry Beds/Tyfry Formation and the Llanddwyn Spilitic Formation have unequivocally lithostratigraphical boundaries (Horák and Gibbons, 2000). If so, they could be reclassified as tectonometamorphic units and given new names like the *Tyfry Sandstone Train* (if there are two or more mappable polygons) and the *Llanddwyn Spilitic Layer* (if the unit is broadly tabular and mapped as a single polygon).
    - d) The Gwna Melange is regarded as an olistostrome and therefore is, in principle, a depositional unit that, *as a whole*, may conform to the Law of Superposition. Assuming that it has a stratigraphical boundary with another *formation* below and/or above, it could be classified with *formation* status and given a name like the *Gwna Melange Formation*. However, it could be argued that internally it is of an extremely mixed nature, and might better be classified as a tectonometamorphic unit. The nature of its lower boundary is apparently equivocal (Gibbons and Ball, 1991; Kawai et al., 2007), so it may be prudent to classify these rocks as, for example, the *Gwna Melange Package*. The term Gwna Group should be deemed obsolete. However, it would still be permissible for the *Gwna Melange Package* to be a stepchild of the *Monian Supergroup*.
  4. The *Coedana Complex* comprises the Coedana Granite and units of mafic gneiss, micaceous gneiss and hornfelsed rocks. If the Coedana Granite is known or inferred to have essentially intrusive boundaries it should be classified and named according to the proposals of Gillespie et al. (2008), for example the *Coedana Granite Pluton*. The relationship between the Coedana Granite and the surrounding gneisses is not clear (McIlroy and Horák, 2006), so a mixed-class unit (e.g. the *Coedana Complex*) could be assigned that would embrace those mappable units. The gneisses have been termed *Mona Gneisses* and *Central Anglesey Gneisses*, and either of these could be classified at Rank 4

and renamed accordingly (e.g. the *Central Anglesey Gneiss Package*) to unite the various units of gneissose rock. Large (>5 km<sup>2</sup>) and small mappable units of hornfelsed rocks are widely developed; these could be classified individually at Rank 6 and united at Rank 5 with a name like the *Llanfihangel Hornfels Swarm*.

5. A belt of pelitic schist and basic meta-igneous rock with greenschist to blueschist assemblages occurs in south-east Anglesey. These unique rocks (possibly the oldest occurrence of glaucophane schist in the world, Horák and Gibbons, 2000) have variably been termed the ‘Penmynydd Zone of Metamorphism’ (Greenly, 1919), ‘Blueschist Belt’ (McIlroy and Horák, 2006), and ‘Eastern Schist Belt’ (Carney et al., 2000), while the BGS Lexicon currently records this unit as the ‘Central Anglesey Shear Zone and Berw Shear Zone – undivided’. The latter designation is unsatisfactory, since rocks from completely different units (e.g. the Arfon Group) have been incorporated locally into the Berw Shear Zone, and also because the Central Anglesey Shear Zone farther north appears to contain a very different range of lithologies from the ‘Blueschist Belt’. A solution that is compatible with the proposed scheme would be to classify the entire belt within a hierarchy of tectonometamorphic units, for example the *Penmynydd Schist Package* (Rank 4), the *Llangafo Micaschist Parcel*, and the *Llanfairpwllgwyngyl. Blueschist Swarm* (Rank 5).
6. If, after such a reclassification, there remain unclassified mappable units in the Central Anglesey Shear Zone or Berw Shear Zone, such shear zones probably should be classified as isolated units, as there is likely to be a conflict of parentage (see also point 7 below).
7. Individual mapped polygons within the Llyn Shear Zone that are not classified as lithostratigraphical units or intrusions should be classified as tectonometamorphic units of Rank 6, and they could be united at Rank 5 within the *Llyn Shear Zone Parcel*. The shear zone separates the *Gwna Melange Package* from the *Sarn Complex*; the latter is not part of the *Anglesey Megacomplex*, so the shear zone is best left as an isolated unit.
8. A number of ‘nested names’ occur within the current stratigraphical framework: for example, the *South Stack Formation* within the *South Stack Group*, the *Skerries Grit Member* within the *Skerries Formation*, the *Coedana Granite Pluton* in the *Coedana Complex*. This situation is not desirable (i.e. it is bad practice to have the same geographical name repeated in different ranks of the same parent–child chain), and it is recommended that when a new stratigraphical framework is erected for Anglesey such conflicts should be avoided.
9. All the above units other than the *Sarn Complex* can be united in the *Anglesey Megacomplex*.

#### **4.6 CLASSIFYING MIXED-CLASS UNITS ENCOMPASSING OPHIOLITE UNITS: THE SHETLAND OPHIOLITE COMPLEX, SHETLAND**

Large parts of the two north-easternmost Shetland islands – Unst and Fetlar – are underlain by ophiolite and by units of intrusive and metasedimentary rocks that have become associated with the ophiolite in the course of obduction and subsequent tectonic processes (Flinn, 2000; Strachan et al., 2002). Table 7 illustrates how these various components could be classified and named according to these proposals, and united in the mixed-class unit *Shetland Ophiolite Complex*:

- numerous unnamed *dykes* of mafite (Rank 6, intrusive units) are united at Rank 5 in a *dyke-swarm* (*Someplace Mafite Dyke-swarm*).

- Numerous mapped bodies of clinopyroxenite–wehrlite – which might originally have formed one or more *layers* in the ultrabasic part of the ophiolite – are classified at Rank 6 as unnamed *masses* and united at Rank 5 in a *parcel* (the *Someplace Clinopyroxenite–wehrlite Parcel*).
- Three major ophiolite *layers*, the *Someplace Clinopyroxenite–wehrlite Parcel*, and the *Someplace Mafite Dyke-swarm* are united at Rank 3 in the mixed-class unit *Shetland Ophiolite*. Other units typical of ophiolite (pillow lava, chert, etc.) are not exposed (at least onshore) in the *Shetland Ophiolite* but could be included in this mixed-class unit if discovered.
- Erosional remnants of supracrustal units that originally were deposited on the obducted ophiolite but are now metamorphosed and allochthonous (due to thrusting and faulting), partly conceal the ophiolite. These units clearly have a depositional origin, but cannot be linked to any formally classified lithostratigraphical parent unit; they are therefore isolated tectonometamorphic units. Structural dismemberment, and the effects of erosion, mean the individual units now generally lack ‘layer’ shape and rectilinear boundaries, and so most of them could be classified at Rank 6 as a *mass*. None of the individual mapped units are named; however, those judged to be related on lithological grounds have previously been given a collective name (e.g. Muness Phyllite, Gruting Greenschist). In Table 7, each of these is united within a *swarm* at Rank 5, e.g. the *Muness Phyllite Swarm*, and *Gruting Greenschist Swarm*.
- Five such *swarms* are united at Rank 4 within the *Unst Metasediment Set*; this classification implies that the various units have a natural association (i.e. a degree of shared geological history and/or character), and that they generally are not contiguous.
- Another single isolated unit, the *Funzie Conglomerate Mass*, and the Rank 5 unit *Norwick Hornblendic Schist Parcel* (which unites several unnamed *masses* of hornblendic schist) are united with the *Unst Metasediment Set* and the *Shetland Ophiolite* at Rank 2 within the mixed-class unit *Shetland Ophiolite Complex*.

#### 4.7 AN EVOLVING CLASSIFICATION: THE HIGHLAND BORDER COMPLEX, SOUTHERN GRAMPIAN HIGHLANDS OF SCOTLAND

The Highland Boundary Fault Zone is a major discontinuity that has for some time now been believed to be a terrane boundary (e.g. Bluck, 2002). Numerous fault strands occur within a complicated fault zone, within which there are many mappable units of the *Dalradian Supergroup*, the Highland Border Ophiolite, and blocks of possible exotic provenance. These units have for many years been referred to collectively as the *Highland Border Complex*. However, recent publications significantly modify that notion, as well as the status of the Highland Boundary Fault Zone (Tanner and Sutherland, 2007; Tanner, 2008).

Table 8a illustrates an attempt to classify the rock units of the ‘classic’ *Highland Border Complex* using the parent–child relationships currently described in the BGS Lexicon. There, units of metasedimentary strata within the Highland Border Complex are defined as having no definable stratigraphical relationship with any adjacent units, such that they cannot be correlated readily with other units outwith the fault zone. The current Lexicon attribution of these lithostratigraphical *formations* is presented in Table 8a but strictly is incompatible with the lithodemic classification now proposed in this report. Instead, these would be *isolated units* and so each should be classified using the hierarchy for tectonometamorphic units (i.e. as a *lens*, *block*, *layer* or *mass* if they are single mappable entities). These ‘*formations*’ are coloured green as tectonometamorphic units in Table 8a. Units of serpentinite and hornblende schist have been

classified here as tectonometamorphic units up to Rank 4, then united with units of pillow lavas at Rank 3 in a mixed-class unit, termed the *Highland Border Ophiolite* for this example. The *Highland Border Ophiolite* and the various units currently classified in the Lexicon as ‘*formations*’ are united at Rank 2 within a mixed-class unit, the *Highland Border Complex*.

Tanner and Sutherland (2007) recently argued, however, that the ‘lithostratigraphical’ units currently included within the Lexicon (Table 8a) are indeed in stratigraphical succession. The authors proposed that they constitute the *Trossachs Group*, the youngest component of the *Dalradian Supergroup*. These units therefore would not conform to the definition of isolated tectonometamorphic units as set out in this report. The *Trossachs Group* stratigraphy of Tanner and Sutherland (2007) is incorporated in the alternative classification (update) of the Highland Border rock units laid out in Table 8b. If, in due course, the geological community adopts the Tanner and Sutherland scheme, many of the units classified within the mixed-class unit *Highland Border Complex* (i.e. the scenario laid out in Table 8a), will be reclassified within the lithostratigraphical *Dalradian Supergroup*. The formal term *Highland Border Complex* arguably will then no longer be required, but might still be used informally to refer to the complicated geological relationships that exist within the confines of the Highland Boundary Fault Zone.

This example illustrates the robustness of the proposed classification scheme in that both alternatives could be equally valid at the present time (accepting that each *formation* in Table 8a be reclassified as a *package* or *set*), and also serves to illustrate the important principle that an agreed classification cannot be fixed in time and can be modified, or even completely changed, if and when new research findings are adopted.

# 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](mailto:libuser@bgs.ac.uk) for details). The library catalogue is available at: <http://geolib.bgs.ac.uk>.

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# Glossary

Glossary of terms for tectonometamorphic units and mixed-class units, and of other terms relevant to these proposals. Terms in bold text denote types of lithodemic unit (see Table 1), and terms in italics are defined elsewhere in the glossary. All terms are nouns, unless indicated otherwise (*adj*).

<b>Term</b>	<b>Definition</b>
allochthonous ( <i>adj</i> )	formed or produced elsewhere than in its present place; cf. <i>autochthonous</i>
<b>assemblage</b>	a <i>tectono-metamorphic unit</i> of Rank 2 uniting two or more <i>tectono-metamorphic units</i> that are of lower rank and display a natural association
autochthonous ( <i>adj</i> )	formed or produced in the place where now found; cf. <i>allochthonous</i>
belt	a large-scale, broadly linear, elongate outcrop of rocks with a degree of shared geological evolution
<b>block</b>	a volume of rock bounded by broadly rectilinear surfaces of tectonic or uncertain origin; also a <i>tectono-metamorphic unit</i> of Rank 6 with these characteristics
body	a volume of geological material distinguished by one or more defining characteristics (compositional, structural, chronological etc)
<b>complex</b>	a <i>mixed-class unit</i> of Rank 2 that unites two or more mixed-class units, or two or more different classes of <i>single-class unit</i> , or a mixture of mixed-class units and single-class units, that are of lower rank and display a natural association; complexes may occur with or without complicated structure
<b>layer</b>	a volume of rock that is, or was formerly, essentially tabular, and is bounded by broadly parallel surfaces of tectonic or uncertain origin; also a <i>tectono-metamorphic unit</i> of Rank 6 with these characteristics
<b>lens</b>	a lensoid <i>body</i> of rock bounded by converging, generally curved surfaces of tectonic or uncertain origin; also a <i>tectono-metamorphic unit</i> of Rank 6 with these characteristics
<b>lithodemic unit</b>	a mappable unit, or group of units, distinguished and delimited on the basis of rock characteristics, that does not obey the Law of Superposition, i.e. is composed predominantly of intrusive and/or strongly deformed and/or strongly metamorphosed rock, or a mixture composed of one or more of these with or without lithostratigraphical units; lithodemic units are the practical units of geological work in regions in which rocks generally lack primary stratification
<b>mass</b>	a <i>body</i> of rock of irregular or unspecified shape, bounded by surfaces of tectonic or uncertain origin; also a <i>tectono-metamorphic unit</i> of Rank 6 with these characteristics
<b>megacomplex</b>	a <i>mixed-class unit</i> of 'Rank 0' that unites two or more mixed-class units, or two or more different classes of <i>single-class units</i> , or a mixture of mixed-class units and single-class units, that are of lower rank and display a natural association; megacomplexes may occur with or without complicated structure
metamorphosed units	a category of the <i>tectono-metamorphic units</i> encompassing those that have been metamorphosed (and commonly deformed) to an extent that the origin of the protolith (depositional or intrusive) cannot be deduced or inferred reliably, or with boundaries modified such that the nature of the original relationship with adjacent units (unconformable/depositional/ intrusive) cannot be determined reliably
mixed-class unit	a <i>lithodemic unit</i> comprising a significant proportion of two or more classes of <i>single-class unit</i> , such that its essential character is 'mixed'; c.f. <i>single-class unit</i>
isolated units	a category of the <i>tectono-metamorphic units</i> encompassing those that are <i>allochthonous</i> and cannot be related reliably to a formally classified lithostratigraphical or intrusive unit
<b>package</b>	a <i>tectono-metamorphic unit</i> of Rank 4 uniting two or more tectono-metamorphic units of lower rank that display a natural association and are largely or wholly contiguous at outcrop; c.f. <i>set</i>
parautochthonous ( <i>adj</i> )	intermediate in tectonic character between <i>autochthonous</i> and <i>allochthonous</i>
<b>parcel</b>	a <i>tectono-metamorphic unit</i> of Rank 5 uniting two or more tectono-metamorphic units of Rank 6 that display a natural association and are largely or wholly contiguous at outcrop; c.f. <i>swarm</i> , <i>train</i>
<b>set</b>	a <i>tectono-metamorphic unit</i> of Rank 4 uniting two or more tectono-metamorphic units of lower rank that display a natural association and are dispersed (not contiguous) at outcrop; c.f. <i>package</i>
shear zone	a <i>zone</i> defined by intense ductile shearing
single-class unit	a lithostratigraphical unit or <i>lithodemic unit</i> that consists wholly or very largely of lithostratigraphical units <u>or</u> intrusive units <u>or</u> <i>tectono-metamorphic units</i> , i.e. its essential character is not 'mixed'; c.f. <i>mixed-class unit</i>
<b>subassemblage</b>	a <i>tectono-metamorphic unit</i> of Rank 3 uniting a subset of the units within an <i>assemblage</i> that display a natural association
<b>subcomplex</b>	a <i>mixed-class unit</i> of Rank 3 uniting a subset of the units within a <i>complex</i> that display a natural association

Glossary (*cont.*)

Term	Definition
<b>superassemblage</b>	a <i>tectono-metamorphic unit</i> of Rank 1 uniting two or more tectono-metamorphic units that are of lower rank and display a natural association
<b>supercomplex</b>	a <i>mixed-class unit</i> of Rank 1 uniting two or more mixed-class units, or two or more different classes of <i>single-class units</i> , or a mixture of mixed-class units and single-class units, that are of lower rank and display a natural association; supercomplexes may occur with or without complicated structure
<b>swarm</b>	a <i>tectono-metamorphic unit</i> of Rank 5 uniting two or more tectono-metamorphic units of Rank 6 that display a natural association and are dispersed (not contiguous) at outcrop; c.f. <i>parcel</i> , <i>train</i> ; a term from Rank 6 of the tectono-metamorphic units hierarchy may be used to qualify the type of swarm, e.g. layer-swarm
tectono-metamorphic unit	a class of <i>lithodemic unit</i> embracing those mappable units whose original character and/or setting has been modified substantially by deformation and/or metamorphism such that they cannot now be classified as, or linked to, a formally recognised lithostratigraphical unit or intrusive unit; two main categories of tectono-metamorphic unit are recognised - <i>metamorphosed units</i> and <i>isolated units</i>
terrane	a fault-bounded <i>body</i> of rock of regional extent, whose geological history contrasts with that of adjacent terranes or continents; generally considered to be a discrete <i>allochthonous</i> fragment of oceanic or continental crust accreted to a craton or terrane at an active margin
<b>train</b>	a <i>tectono-metamorphic unit</i> of Rank 5 uniting two or more tectono-metamorphic units of Rank 6 that display a natural association and have a dispersed but broadly linear spatial arrangement at outcrop; c.f. <i>swarm</i> , <i>parcel</i>
zone	a volume or area of geological material in which the frequency of a feature, or the degree to which a particular state or condition is developed, is measurably higher than in the background

**Table 1** The BGS classification of lithostratigraphical and lithodemic units.

		Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1	'Rank 0'	
<b>SINGLE-CLASS UNITS</b>	<b>Lithostratigraphical units</b>	bed flow	member	formation	subgroup	group	supergroup		
	<b>Lithodemic units</b>	<b>Intrusive units</b>	intrusion	pluton ring-intrusion lopolith intrusion-swarm	<b>centre cluster</b>	<b>subsuite</b>	<b>suite</b>	<b>supersuite</b>	
			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			ring-swarm						
cone-sheet			cone-sheet-swarm						
vein			vein-swarm						
<b>Tectono-metamorphic units</b>	lens block layer mass	train, swarm (dispersed) parcel (contiguous)	set (dispersed) package (contiguous)	<b>subassemblage</b>	<b>assemblage</b>	<b>superassemblage</b>			
<b>MIXED-CLASS UNITS</b>	Special cases:			ring-complex* sheet-complex* sill-complex* vein-complex*	subcomplex ophiolite central complex* volcano-complex*	<b>complex</b>	<b>supercomplex</b>	<b>megacomplex</b>	

Colour code:

	Lithostratigraphical units
	Intrusive units
	Tectono-metamorphic units
	Mixed-class units

\* These widely used terms denote mixed class units that consist mainly of intrusive rock. Others may be defined in due course, if a need is demonstrated.

**Table 2** Classifying strongly deformed metasedimentary units: the Dava and Glen Banchor groups, northern Grampian Highlands of Scotland.

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1	
Individual mappable units not recognised to date	Someplace Metapsammite Member	Someplace Striped Formation	A'Chailleach Subgroup	Glen Banchor Group GLBA	Badenloch Supergroup	
	unnamed members of migmatitic quartzite					
	unnamed members of gneissose metasemipelite, metapsammite and siliceous metapsammite					
	Someplace Metapsammite Member	Someplace Metasemipelite Formation	Someplace Subgroup			
	unnamed members of metasemipelite and calcsilicate rock					
	unnamed members of metasemipelite and metapsammite					
	Someplace Metasemipelite Member	Someplace Metapsammite Formation	Someplace Subgroup			
	unnamed members of quartzite					
	unnamed members of gneissose metapsammite and siliceous metapsammite					
	Someplace Micaceous Metapsammite Member	Flichtity Metasemipelite Formation	Slochd–Strathdearn Subgroup	Dava Group DAVA		
	unnamed members of quartzite	FCHY				
	unnamed members of metasemipelite	Slochd Metapsammite Formation				
	unnamed members of metasemipelite					SLCD
	unnamed members of quartzite					
	unnamed members of metapsammite	Beinn Bhreac Metapsammite Formation				
	unnamed members of metasemipelite		BBPS			
unnamed members of quartzite						
unnamed members of metapsammite	Creag Bhuidhe Metasemipelite Member					

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

This example is based on units that crop out in the area of the Tomatin sheet (British Geological Survey 2004)

**Table 3** Classifying tectonometamorphic units: the Moine Thrust Mylonite Set, north-west Scotland.

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1
unnamed layers of carbonate-mylonite	Someplace Carbonate-mylonite Parcel (probable protolith Durness Group)	<b>Moine Thrust Mylonite Set MTZM</b> (currently Moine Thrust Mylonite Complex)			
unnamed layers of quartzitic-mylonite	Someplace Quartzitic-mylonite Parcel (probable protolith Eriboll Formation)				
unnamed layers of mylonitic gneiss	Someplace Mylonitic Gneiss Parcel (probable protolith Lewisian Supercomplex)				
unnamed layers of Oystershell Rock	Someplace Oystershell Rock Parcel (probable protolith Lewisian Supercomplex)				

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

**Table 4** Classifying single-class units that include minor components of another class: the Moine Supergroup of the Northern Highlands of Scotland.

		Scaraben Quartzite Formation SCAB	could be children of Loch Eil Group, Sutherland Assemblage, or Moine Supergroup - see text	Sutherland Assemblage (The Lexcode GLEIL: "Glenfinnan and/or Loch Eil Group - undifferentiated" should be abandoned). Links with Loch Eil and Glenfinnan are tenuous and uncertain.	Moine Supergroup M
		Suisgill Metasemipelite Formation SUIS			
		Kildonan Metapsammite Formation KILD			
		Portskerra Metapsammite Formation PORK			
	Someplace Migmatitic Metasemipelite Parcel	Loch Coire Migmatite Package LOCE* (currently Loch Coire Formation)			
	Someplace Migmatitic Metasemipelite Parcel				
	Someplace Migmatitic Metapelite Parcel				
	Badanloch Granite Sheet-swarm BADG* (partial melts of Loch Coire Migmatite Package and the Kildonan Metapsammite Formation; currently a child of HOMI, see text)				
	Swordly Metapelite Parcel SWOR* (currently Swordly Pelite Member, without a parent formation)	Kirtomy Gneiss Set KIRY* (currently Kirtomy Gneisses)			
		Bettyhill Gneiss Package BTYH* (currently Bettyhill Formation)			
		Druimh Chuibe Metapsammite Formation			
		Loch Eil Metapsammite Formation (not subdivided / no codes)	Loch Eil Group LEIL		
		Druim na Saille Metapelite Formation DRSP	Glenfinnan Group GLEN		
		Beinn an Tuim Striped Formation BTU			
		Lochailort Metapelite Formation MBLA			
		Resipol Striped Formation RESI			
		Upper Morar Metapsammite Formation MAUP	Morar Group MORR		
		Morar Schists Formation MAMS			
		Lower Morar Metapsammite Formation MALP			
		Basal Metapelite Formation MABP			
		Cromm Metapsammite Formation CMPS			
		Vaich Metapelite Formation VAPE			
		Glascarnoch Metapsammite Formation GLPS			
	Glen Achall Metapsammite–Metasemipelite Member GACH	Altnaharra Metapsammite Formation ALPS			
	Achness Metasemipelite Member				
	Someplace Gneiss Parcel	Strathy Gneiss Package MSC (an isolated unit; currently Strathy Complex)			
	Port Mor Marble Parcel				
	Someplace Quartz–Garnet–Magnetite Parcel				
		Tarskavaig Metapsammite Package TARS* (an isolated unit, see text) or Aruisg Metapsammite Formation ARU*			
	Ardgour Granite Gneiss Pluton		West Highland Granite Gneiss Suite WHGG		
	Fort Augustus Granite Gneiss Pluton				
	Loch Arkaig Granite Gneiss Pluton				
Unnamed granite gneiss intrusions (WHGG - undivided)					

Notes: \* An appropriate Lexcode already exist for these units; only their lithodemic definitions may need changing.

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

**Table 5** Classifying mixed-class units: the Lewisian Supercomplex, north-west Scotland.

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1	
Gorm Cnoc Metagabbro Mass	Cnoc Gorm Metagabbro Swarm (note the boundaries of these bodies are highly sheared and not intrusive, hence they are deemed to be 'metamorphosed units' rather than intrusive units)			Scourian Gneiss Assemblage LS	<b>LEWISIAN SUPERCOMPLEX (1)</b>	
Ben Strome Metagabbro Mass						
Scouriemore Metagabbro Mass						
unnamed masses of metagabbro						
unnamed masses of mafic orthogneiss	Someplace Mafic Orthogneiss Parcel	Someplace Gneiss Package				
unnamed masses of felsic orthogneiss	Someplace Felsic Orthogneiss Parcel					
unnamed veins of pegmatitic granite	Someplace Pegmatitic Granite Vein-swarm					
	Foindle Amphibolite Parcel	Claisfean Supracrustal Set				
	Tarbet Metapsammite and Quartzite Parcel					
	Lochinver Supracrustal Parcel					
	Someplace Orthogneiss Parcel ICGN - OGNSS			Inchard Gneiss Assemblage ICGN		
	Someplace Mafic Orthogneiss Parcel ICGN - OGNM					
unnamed veins of pegmatitic granite	Someplace Pegmatitic Granite Vein-swarm					
unnamed sheets of granite	Rubha Ruadh Granite Sheet-swarm RUBR-GGPG / RUBR-PPGN	Laxfordian Granite Cluster LLX				
unnamed sheets of granite	Loch Stack Granite Sheet-swarm					
	Achall Gneiss Parcel	Ullapool Gneiss Set ULLA		Possibly part of Scourian Gneiss Assemblage LS		
	Langwell Gneiss Parcel					
	Corrie Point Gneiss Parcel					
	unnamed gneiss parcels....		Gruinard Bay Gneiss Package			
	Aundrary Amphibolite Parcel					
Flowerdale Marble Layer	Flowerdale Metasemipelite Parcel			Loch Maree Assemblage LMG (changed status from 'Group')		
	Kerrysdale Amphibolite Parcel			OR:		
	Ard Granite Gneiss Parcel					
Mill na Claise Gneiss Mass				Loch Maree Complex (defined as a mixed-class unit)		
	Charlestown Schist Parcel					
unnamed veins of pegmatitic granite	Someplace Pegmatitic Granite Vein-swarm					
	Ialltaig Gneiss Parcel					
unnamed dykes of metapicrite	Beannach Metapicrite Dyke-swarm BMP-MPCT			Scourie Dyke Suite SCOUR		
unnamed dykes of meta-clinopyroxene-norite	Badcall Meta-clinopyroxene-norite Dyke-swarm BMCN-MNO					
unnamed dykes of meta-olivine-gabbro	Sionascaig Meta-olivine-gabbro Dyke-swarm SMOG-MGAB					
unnamed dykes of dolerite	Someplace Dolerite Dyke-swarm SCOUR-AMPH					

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

**Table 6** Classifying mixed-class units: the Anglesey Megacomplex, north-west Wales.

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1	'Rank 0'
	Gwyddell Chert Block-swarm NW (currently Gwyddell Beds or Gwyddel Felsitic Formation)	Gwna Melange Package (currently Gwna Group NGW or Gwna Melange Formation GWNM)			Mortian Supergroup N	Anglesey Megacomplex
	Fydlyn Felsitic Parcel NFFF (currently Fydlyn Felsitic Formation)					
	Bardsey Island Granite Block-swarm					
	Tyfry Sandstone Train NKTB (currently Tyfry Formation)					
	Llandwyn Spilitic Parcel (currently Llandwyn Formation; in BGS Lexicon as Ceinwen and Llandwyn Spilitic Formation NWCL)					
Unnamed blocks of quartzite	Someplace Quartzite Block-swarm					
Unnamed blocks of limestone	Someplace Limestone Block-swarm					
Unnamed blocks of basalt	Someplace Basalt Block-swarm					
	Someplace Quartz-chlorite-mica-schist Parcel (the 'matrix')					
	Skerries Grits Member NKSG Church Bay Tuffs Member NXCT		Skerries Formation NK			
	Someplace Metagabbro Block-swarm Cae'r Sais Serpentine Block-swarm	Lynas Metapsammite Formation Bodelwyn Metapelite Formation				
		Rhoscolyn Formation NSR				
	Holyhead Quartzite Member NHQ	Holyhead Formation HDD South Stack Formation NSS		Holy Island Group NHI		
	Llangafo Mica Schist Parcel Someplace Hornblende Schist Train Llanfairpwllgwyngyll. Blueschist Swarm Someplace Quartz Schist Parcel Someplace Limestone-graphite Schist Swarm	Penmynydd Schist Package (also termed: Eastern Schist Belt; Blueschist Belt; Central Anglesey Shear Zone and Berw Shear Zone - undiv CABSZ)				
	Coedana Granite Pluton COEDG Llanfihangel Hornfels Swarm Someplace Mafic Gneiss Parcel Someplace Micaceous Gneiss Parcel Someplace Granite Gneiss Swarm	Mona Gneiss Package NMG (or re-instate <i>Central Anglesey Gneiss Package</i> )		Coedana Complex COED		
	Llyn Shear Zone Parcel LSZ	an isolated unit, as there is conflict of parentage (Gwna Melange & Sarn Complex)				
	Parwyd Gneiss Parcel PWYD (currently Parwyd Gneiss) Sarn Granite Pluton Someplace Diorite Pluton Someplace Gabbro Pluton			Sarn Complex SRN		

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

**Table 7** Classifying mixed-class units encompassing ophiolite units: the Shetland Ophiolite Complex, Shetland.

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1		
unnamed dykes of mafite	Someplace Mafite Dyke-swarm		Shetland Ophiolite	Shetland Ophiolite Complex SHOP	British Iapetan Ophiolite Supercomplex		
Someplace Metagabbro Layer							
Someplace Metadunite Layer							
unnamed masses of clinopyroxenite–wehrlite	Someplace Clinopyroxenite–wehrlite Parcel						
Someplace Metaharzburgite Layer							
unnamed masses of phyllite	Muness Phyllite Swarm MUNP (currently Muness Phyllites Formation)	Unst Metasediment Set (formerly Unst Phyllite group? - UNPH)	Shetland Ophiolite Complex SHOP			British Iapetan Ophiolite Supercomplex	
unnamed masses of graphitic-schist	Norwick Graphitic-schist Swarm NORG (currently Norwick Graphitic-schist Formation)						
unnamed masses of phyllite	Norwick Phyllite Swarm NORP (currently Norwick Phyllite Formation)						
unnamed masses of metapelite	Leagarth Metapelite Swarm LEGP (currently Leagarth Pelite Formation)						
unnamed masses of greenschist	Gruting Greenschist Swarm GRUT (currently Gruting Greenschist Formation)						
Funzie Conglomerate Mass FUNC (currently Funzie Conglomerate Formation)				Shetland Ophiolite Complex SHOP	British Iapetan Ophiolite Supercomplex		
unnamed masses of hornblende schist	Norwick Hornblende Schist Parcel NORH1, NORH2, NORH3						

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

**Table 8** An evolving classification: the Highland Border Complex, Southern Grampian Highlands of Scotland.

**Table 8a - alternative 1** (before Tanner & Sutherland, 2007)

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1
		Bofrishlie Slate Formation * BLSL		Highland Border Complex (HBX)	
		Burn of Mar Sandstone Formation * BMSA			
		Dounans Limestone Formation * DSLM			
		Loch Fad Conglomerate Formation * LFC			
	Margie Limestone Member * DCML	Margie Formation * MARG			
		North Esk Formation * NOE			
unnamed masses of hornblende schist	Corrie Burn Hornblende Schist Train CBHS (currently Corrie Burn Hornblende Schist)	Maol Ruadh Hornblende Schist Package	Highland Border Ophiolite		
unnamed masses of serpentinite	Lime Hill Serpentinite Train LHSP (currently Lime Hill Serpentinite)	Aberfoyle Serpentinite Set			
unnamed units of basaltic pillow lava	Someplace Pillow Lavas Swarm				

\* the lithostratigraphical names for these units reflect current entries in the BGS Lexicon of Named Rock Units, however according to the proposals set out in this report these are tectono-metamorphic units and (and hence are shown in green block).

**Table 8b - alternative 2** (after Tanner & Sutherland, 2007)

Rank 6	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1
		Bofrishlie Slate Formation BLSL		Trossachs Group TROS	Dalradian Supergroup DALN
		Burn of Mar Sandstone Formation BMSA			
		Dounans Limestone Formation DSLM			
		Loch Fad Conglomerate Formation LFC			
	Margie Limestone Member DCML	Margie Formation MARG			
		North Esk Formation NOE			
unnamed masses of hornblende schist	Corrie Burn Hornblende Schist Train CBHS (currently Corrie Burn Hornblende Schist)	Maol Ruadh Hornblende Schist Package	Highland Border Ophiolite		British Iapetan Ophiolite Supercomplex
unnamed masses of serpentinite	Lime Hill Serpentinite Train LHSP (currently Lime Hill Serpentinite)	Aberfoyle Serpentinite Set			
unnamed units of basaltic pillow lava	Someplace Pillow Lavas Swarm				

**Colour codes:**

	Lithostratigraphical
	Intrusive
	Tectono-metamorphic
	Mixed-class

If all mapped units in the *Highland Border Complex* ultimately are assigned to either the *Dalradian Supergroup* or *Highland Border Ophiolite Complex*, the term 'Highland Border Complex' may become redundant as a formal name. It might still be used informally to refer to the complicated geological relationships that exist within the confines of the Highland Boundary Fault Zone.

The British Iapetan Ophiolite Supercomplex could also be the parent to the Shetland and Ballantrae ophiolites