Working Report 2006-32

A System of Nomenclature for Rocks in Olkiluoto

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ABSTRACT

Due to international interest in the Finnish deep repository project at Olkiluoto (SW Finland) and the need for collaboration between scientists involved in site investigations for the disposal of spent nuclear fuel in other countries, a well-documented system of rock nomenclature is required, based on existing classification schemes and international recommendations. The BGS (British Geological Survey) rock classification scheme is the most comprehensive rock classification scheme and the basic principles behind it are utilised for the system of nomenclature for rocks in Olkiluoto. The BGS classification system is based on the use of descriptive names and a clear hierarchy, making it possible to classify rocks at different levels depending on the specific goals of the study, the level of available information, and the expertise of the user. Each rock type is assigned a *root name*, which is based on structural and textural characteristics or modal compositions of the rock and the root names are refined with *qualifier terms* as prefixes. Qualifier terms refer to the structure or modal composition of the rock.

The bedrock at the Olkiluoto site consists of metamorphic and igneous rocks. The metamorphic rocks consist of migmatitic gneisses and (non-migmatitic) gneisses, which are further divided according to their structural characteristics and modal compositions, the former into stromatic, veined, diatexitic gneisses, the latter into mica, quartz, mafic and TGG gneisses. Igneous rocks consist of pegmatitic granites, K-feldspar porphyry and diabases.

Keywords: Rock classification, rock nomenclature, metamorphic rocks, igneous rocks, Olkiluoto, Finland, disposal of spent nuclear fuel

OLKILUODON KIVIEN NIMEÄMISKÄYTÄNTÖ

TIIVISTELMÄ

Ydinjätteiden loppusijoitukseen liittyvän kansainvälisen kiinnostuksen ja yhteistyön vuoksi on kivien luokittelussa ja nimeämisessä tarpeellista noudattaa olemassa olevia luokitussysteemejä sekä kansainvälisiä suosituksia. Britannian geologian tutkimuskeskuksen (BGS) kivien luokittelusysteemi on ainoa olemassa oleva perusteellinen kivien luokittelusysteemi ja sen perusperiaatteita on myös käytetty Olkiluodon kivien nimeämisessä. BGS:n luokittelusysteemi perustuu kuvailevien termien sekä hierarkian käyttöön, joka mahdollistaa kivien luokittelun eri tasoilla riippuen tehtävän tutkimuksen tarkoituksesta, käytettävissä olevan tiedon määrästä sekä käyttäjän asiantuntemuksesta. Luokittelusysteemissä jokaiselle kivilajille määritellään perusnimi, joka pohjautuu kiven rakenteeseen, tekstuuriin tai modaaliseen koostumukseen ja lisäksi perusnimeä voidaan täydentää ylimääräisillä määritteillä, jotka perustuvat kiven rakenteeseen, tekstuuriin tai mineralogiaan.

Olkiluodon metamorfiset kivet koostuvat migmatiittisista sekä (ei-migmatiittisista) gneisseistä, jotka voidaan edelleen jakaa alaluokkiin kiven rakenteen ja mineralogian perusteella. Alaluokkia ovat stromaattiset, suoni-, diateksiittiset, kiille-, kvartsi-, mafiset ja TGG-gneissit. Syväkivet muodostuvat puolestaan pegmatiittisistä graniiteista, K-maasälpäporfyyreistä sekä diabaaseista.

Asiasanat: Kivien luokitus, kivien nimeäminen, metamorfiset kivet, syväkivet, Olkiluoto, Suomi, ydinjätteiden loppusijoitus

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1 INTRODUCTION

Due to international interest in the Finnish deep repository project at Olkiluoto (SW Finland) and the need for collaboration between scientists involved in site investigations for the disposal of spent nuclear fuel in other countries, a well-documented system of rock nomenclature is required, based on existing classification schemes and international recommendations. Any good and practical system of rock classification (or any other classification system) should fulfil the following requirements:

- The scheme should be based on *descriptive terms*, which can be determined unambiguously based on features directly observable in the field. Apart from the primary classification of rocks into metamorphic, igneous and sedimentary, any genetic terms should be disfavoured, since understanding of the genetic nature of rocks may change within time, whereas the textural, structural and modal properties of rocks do not.

- The scheme should have a *hierarchical structure*, which is a prerequisite for being simple and practical in application, proceeding in a series of levels and giving the possibility of classifying rocks in different levels according to the level of information available and the expertise of the user.

- Well-established names should be used as far as possible, yet changes should be allowed if necessary. Changes may be necessary, for example, in cases where the existing terminology does not fully describe the whole scale of rock characteristics and does not serve the goal of a specific study. Careful documentation of such changes is important in any proposed classification scheme.

This report introduces a system of nomenclature, which is applicable to Olkiluoto during the presently ongoing site confirmation studies and establishes a link to existing classification schemes and international recommendations.

2 BACKGROUND FOR THE NOMENCLATURE

IUGS (International Union of Geological Sciences) and its subcommissions are currently working towards the establishment of unified terminology and classification of rock types. However, the work is far from ready and so far the IUGS has only produced general principles and recommendations on the use of terms. The process of introducing a comprehensive classification system is still some time in the future. The BGS (British Geological Survey) rock classification scheme (Robertson 1999, Gillespie & Styles 1999) is at present the most comprehensive classification system for rocks. It adopts the general principles of the current IUGS recommendations, yet, as stated by Gillespie & Styles (1999), it "*... contains many refinements and changes to the IUGS recommendations, where it was considered necessary and appropriate, and the resulting scheme is more logical, consistent, systematic and clearly defined*". The basic principle of the BGS scheme is the use of a relatively small amount of accepted ***root names*** with or without ***qualifier terms*****,** based, as far as possible, on descriptive attributes. The use of genetic terms is discouraged, as opinions on the genetic factors of rocks are likely to change during time whereas textural and structural characteristics and modal compositions do not. These basic principles have also been utilised in the nomenclature of rocks in Olkiluoto

3 NOMENCLATURE FOR ROCKS IN OLKILUOTO

3.1 Basic concepts and subdivision of the rock types

The bedrock at the Olkiluoto site consists of two main types of rock, metamorphic rocks and igneous rocks (treated separately in the BGS system in the reports of Robertson 1999 and Gillespie & Styles 1999, respectively).

The metamorphic rocks in Olkiluoto are *gneisses,* based on their texture and grain size, and can be further divided into *migmatitic gneisses* and *(non-migmatitic)*[1] *gneisses*. Migmatitic gneisses can be classified according to the migmatitic *structure* of the rock into *stromatic, veined* and *diatexitic* gneisses. (Non-migmatitic) gneisses consist of four subgroups, which are named according to their modal composition as *mica, quartz, mafic* and *TGG gneisses.*

Igneous rocks are subdivided into *pegmatitic granites, K-feldspar porphyry* and *diabase*. Igneous rocks are named according to their modal composition and texture, with the exception of diabase, which is named according to its field association, i.e. diabase is a basaltic rock occurring as dikes and sills.

The subdivision of the rocks in Olkiluoto is shown in Figure 1.

[1] *The term non-migmatitic is a trivial qualifier term, which has been implemented in the system of nomenclature to indicate the difference between actual migmatitic gneisses and other gneisses with basically non-migmatitic character and to sustain the hierarchical scheme (see Figure1 and Appendix 1). In spoken language, the term gneiss should be used instead of the term non-migmatitic gneiss (or, preferably, to speak of mica, quartz, mafic and TGG gneisses).*

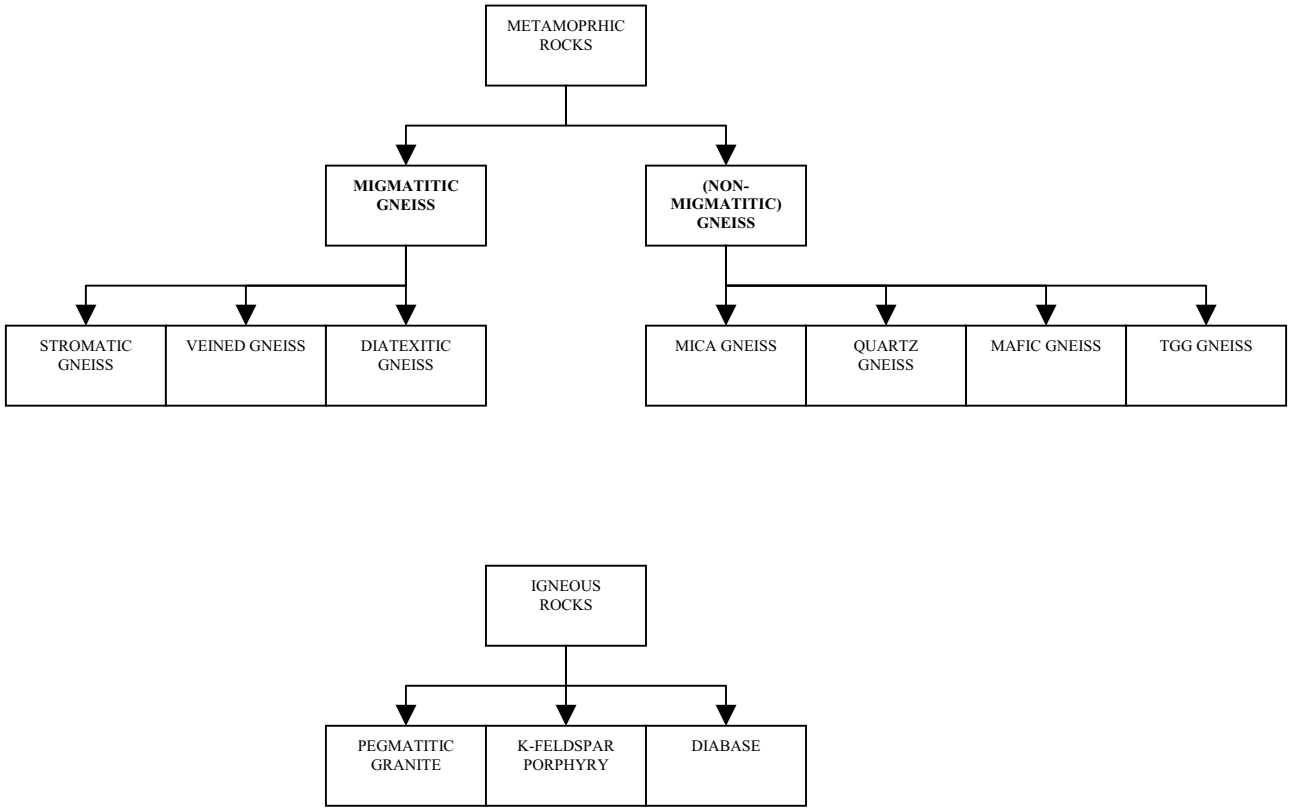

Figure 1. *Diagram showing the subdivision of rock types in Olkiluoto*

3.2 Root names and qualifier terms

In the following text, root names and qualifier terms accepted for the nomenclature of rocks in Olkiluoto are briefly explained and a short discussion on the published definitions of the terms is also provided.

3.2.1 Metamorphic rocks

Root names

According to recommendation of the BGS rock classification scheme, metamorphic rocks with unknown or undefined protolith should be classified either as ***slate***, ***schist***, ***gneiss***, ***granofels*** or ***hornfels***. By the definition of Robertson (1999), gneiss is a medium- to coarse-grained inhomogeneous rock, which is characterised by a well-developed foliation or preferred orientation of constituent minerals. As this description is applicable to the majority of metamorphic rocks in Olkiluoto, the term "gneiss" is used as a root name for all types.

Other root names for metamorphic rocks are not used in the current system of nomenclature; however, two levels of qualifier terms are introduced. First, the gneisses are subdivided into two main groups, migmatitic gneisses and (non-migmatitic) gneisses, and then each group is further subdivided using more specific qualifiers, as explained below

Qualifier terms

The BGS classification system proposes certain qualifier terms for metamorphic rocks, but as the list is inadequate to describe the full spectrum of structures of metamorphic rocks in Olkiluoto, certain qualifiers are adopted from the publications of Mehnert (1968) and Wimmenauer and Bryhni (2002) and modified to correspond to the recommendations of BGS classification scheme, e.g. the term *diatexite* (corresponding to root name) is changed into a descriptive term *diatexitic* (corresponding thereafter to a qualifier term). The gneisses in Olkiluoto are divided into two major subgroups, ***migmatitic gneisses*** and ***(non-migmatitic) gneisses***, which are treated separately below.

Migmatitic gneisses

The qualifier term ***migmatitic*** refers to rocks, which are, according to Robertson (1999) *"...megascopically composite, consisting of two or more petrographically different parts, one of which is the country rock in a more or less metamorphic state, the other is of pegmatitic, aplitic, or granitic appearance"*. The pegmatitic, aplitic and granitic parts comprise the leucosome[2] of the migmatitic rock and in Olkiluoto can also be tonalitic in modal composition. Note that the term ***migmatite***[3] is not applicable in this nomenclature as it is not a single rock type.

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[2] *By the definition of Robertson (1999), leucosome is the leucocratic (light-coloured), quartzofeldspathic or feldspathic part of the rock and can be of variable scale whereas melanosome is the melanocratic (dark-coloured) or mafic-rich portion of the migmatitic rock. Mesosome (mesocratic = grey-coloured) is the fraction of rock which has the appearance ordinary metamorphic rock, i.e. in Olkiluoto it corresponds to the gneissic part of the migmatitic rock.*

[3] *The term migmatite is used widely as a synonym for migmatitic metasedimentary rocks. However, as pointed out in the preceeding text, migmatite is not an explicit term as it describes a wide variety of rocks (for example, amphibolite and gneiss injected by leucocratic rock are both migmatitic and therefore, by definition, migmatites). Therefore the more explicit (and descriptive) qualifier term migmatitic should be used.*

Migmatitic gneisses can be further divided into three subgroups, which are labelled ***stromatic***, ***veined*** and ***diatexitic gneisses***, based on the type of migmatitic structure. However, it should be noted that the essence of migmatitic rocks is gradation, i.e. different migmatitic variants do not form strictly definable entities, but form transitional systems where one migmatitic structure grades into another. Therefore, the classification of migmatitic rocks at this level requires certain amount of subjective decision.

By the definition of Robertson (1999), stromatic rocks are *"...migmatitic rocks where the leucosome and mesosome have a layered structure"*. Similarly, Mehnert (1968) described stromatic rocks as ones in which the *"neosomes (leucosomes) form light and dark layers in the paleosome generally parallel to the plane of schistosity"*. In the nomenclature of rocks in Olkiluoto, the ***stromatic gneisses*** are migmatitic gneisses with a banded appearance in which the leucosome layers vary in width from several millimetres to 10 – 20 cm. The mesosome in these migmatitic rocks is often well foliated and shows a metamorphic banding or schistosity. Stromatic gneisses may contain 10-50% of leucosome.

Veined gneisses are varieties of migmatitic gneisses, which contain elongated leucosome veins with thicknesses varying from several millimetres up to ten centimetres. The leucosome veins show a distinct lensoid shape, sometimes appearing as pinch-and-swell structures, and may consist of augen-like quartz-feldspar aggregates. Migmatitic gneisses with phelibitic, folded and ophthalmitic structure (Mehnert 1968) are included in this group. In addition, features of other structure types such as diktyonic structure, surreitic structure and ptygmatic structure are also included into this subgroup. Veined gneisses may contain 10-50% of leucosome.

According to Wimmenauer & Bryhni (2002), term *diatexite* refers to migmatitic rocks *"...where the darker and lighter parts form schlieren and nebulitic structures which merge into one-another"*. They also point out that as the term diatexite refers to the genetic term *diatexis*, a descriptive definition of the rock type is also needed. By another definition, diatexite has been defined as a variety of migmatitic rocks, in which the pre-migmatization structures are destroyed (Brown 1973). In the nomenclature of metamorphic rocks in Olkiluoto, the term *diatexitic* is therefore applied as a qualifier term for a certain variety of migmatitic gneisses, which typically have a high proportion (20-80%) of leucosome and in which the shapes of the palaeosome and leucosome are random, structurally asymmetric and have diffuse contacts. Migmatitic gneisses with structures such as nebulitic, stictolithic and schollen are included in this subgroup. The definition of ***diatexitic gneiss*** at Olkiluoto, therefore, corresponds to the definitions of Wimmenauer & Bryhni (2002) and Brown (1973). It is emphasised that the term *diatexitic* is used in this system purely as a descriptive qualifier term and it should not be confused to the genetic term diatexis.

(Non-migmatitic) gneisses

(Non-migmatitic) gneisses are divided into four subgroups, labelled as ***TGG-***, ***mafic***, ***quartz*** and ***mica gneisses***, and the qualifier terms of these rocks are based on the modal composition or dominating minerals of the rock. Modal compositions are defined on the basis of the BGS rock classification scheme for igneous rocks (Gillespie & Styles 1999).

TGG refers to gneiss variant, in which the rocks are medium-grained and relatively homogeneous, often showing a weak metamorphic banding or gneissic foliation, but also in some places resembling plutonic, non-foliated rocks. The abbreviation TGG refers to modal composition of the parent rock, i.e. an abbreviation for ***t****onalitic-****g****ranitic-****g****ranodioritic gneiss.* Independent of the modal composition, i.e. whether the rocks are tonalitic, granodioritic or granitic, these rocks are placed in the category of TGG gneisses.

Mafic gneisses are mesocratic to melanocratic metamorphic rocks, which typically contain more than 35 percent of mafic minerals (term mafic refers to the dark colour of the constituting minerals). The mafic minerals are typically hornblende or chlorite, but gneiss variants, which contain pyroxene or olivine, are also included in this group. If biotite is the dominant mafic mineral, the rock is placed in the next category.

The prefix *mica* refers to rocks with high content of mica minerals, and the corresponding mica gneisses are typically derived from pelitic or semipelitic protoliths. The fine-grained mica gneisses are typically schistose, whereas the medium-grained varieties usually show a distinct metamorphic banding or gneissic foliation.

The qualifier term *quartz* is used as a prefix for gneisses which contain more than 60% quartz and feldspars, and less than 20% micas. Some quartz gneiss variants may also contain some amphibole and also, in addition, pyroxene. Garnet is also a typical constituent of quartz gneisses.

Mica gneisses, which contain more than 10% of leucosome and TGG gneisses with more than 20% of leucosome, are named according to the scheme for migmatitic gneisses.

3.2.2 Igneous rocks

Root names

Igneous rocks are classified according to the BGS classification scheme for igneous rocks (Gillespie & Styles 1999) and the accepted root names are ***granite*** and ***porphyry***, which correspond to granitic, medium- to coarse-grained igneous rocks, and ***diabase***, which is a widely-used term for fine- to medium-grained basaltic rocks in Finland.

Granite is a root name for igneous rocks constituted mainly of feldspars and quartz, according to the QAP-classification (Streckeisen 1976), i.e. based on modal composition, without any genetic implications.

Porphyry[4] refers to rocks *"...containing phenocrysts and with an aphanitic groundmass of indeterminate composition"* (Gillespie & Styles 1999). This root name is adopted in Olkiluoto for rocks with igneous, homogenous character consisting of granitic, tonalitic or granodioritic groundmass and with sub- to euhedral K-feldspar phenocrysts.

Diabase is used to denote fine-to medium-grained rocks of basaltic composition occurring as dykes and sills, i.e. the term refers both to the field association and modal composition. Ophitic textures are typical for these rocks. Note, however, that in the BGS rock classification scheme for igneous rocks (Gillespie & Styles 1999) the term *diabase* is not favoured and it is recommended that either the term *microgabbro* or *dolerite* should be used. However, due to the widespread use of the term *diabase* in Finland, it is also accepted in the nomenclature of rocks in Olkiluoto.

Qualifier terms

The prefix *pegmatitic* is used as a qualifier term in conjunction with applicable root names for relatively coarse-grained rocks and with no implications as to the modal composition of the rock. The term ***pegmatite*** is not used as a root name in this scheme.

Rocks with the root name *porphyry* should have a mineralogical qualifier term as a prefix, which indicates the mineralogy of the phenocrysts. In Olkiluoto, the applicable mineralogical term is *K-feldspar*, i.e. denoting that the phenocrysts in the porphyry are K-feldspar.

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[4] *By the definition of Gillespie & Styles (1999) porphyry has an aphanitic groundmass, but it should be noted, however, that this definition is not entirely correct in respect to the actual rock type observed in Olkiluoto. Aphanitic refers to rocks, which have a very fine-grained groundmass while the rocks in Olkiluoto, assigned the name porphyry, have typically medium-grained groundmass. Nevertheless, the term porphyry has been adopted for the current nomenclature and denotes to rocks with igneous and homogenous character, consisting of granitic, tonalitic or granodioritic groundmass and with sub- to euhedral K-feldspar phenocrysts.*

4 USING DIFFERENT LEVELS OF HIERARCHY IN THE NOMENCLATURE OF ROCKS

The basic concept of the BGS rock classification scheme is *hierarchy*, i.e. rocks can be named at different levels depending on the amount of available information and the expertise of the user of the system. Similarly, the current system of nomenclature of rocks in Olkiluoto adopts the same principle and the corresponding hierarchy is presented in Appendix 1. The use of the different levels of the hierarchy is briefly outlined below. For further details, the reader is referred to the BGS classification scheme (Robertson 1999, Gillespie & Styles 1999).

Level 1 of the hierarchy is a very trivial one, indicating that the system is used for the classification of rocks and deposits and as such is not a valid level of nomenclature for rocks as it contains no information related to the *types* of rocks.

Level 2 consists of four different classes, i.e. metamorphic rocks, igneous rocks, sedimentary rocks and superficial deposits, and is already much more informative, as it defines the basic character of the rocks which can occur in any region. Note that although the BGS rock classification system also allows the classification of sedimentary rocks (Hallsworth & Knox 1999) and superficial deposits (McMillan & Powell 1999), these are not within the scope of the present report (sedimentary rocks do not occur in the bedrock at Olkiluoto, and superficial deposits are not the subject of this report).

In levels 3 and 4, the level 2 rock categories are further divided based on their characteristic properties, each category now being treated separately. For this reason, the subdivisions of metamorphic rocks and igneous rocks are given on separate "trees" in Fig. 1. For a more detailed description on the procedures for classifying rocks at these levels, reference is made to the BGS rock classification scheme (Robertson 1999, Gillespie & Styles 1999). Note, however, that in the system of nomenclature for rocks in Olkiluoto, metamorphic rocks are classified according to the BGS system 'protolith undefined' (level 3), and named according to textural properties (level 4). Similarly, igneous rocks are classified according to the system 'crystalline igneous rocks' (level 3) and 'normal igneous rocks' (level 4).

Level 5 is the first practical level in the classification of rocks as it provides a simple basis for a field classification, based on textural properties and grain-size. Without any further knowledge on the composition and properties of the rocks, metamorphic rocks can be subdivided into a number of categories, including the category "gneiss". Similarly, igneous rocks are subdivided according to approximate (field-determined) mineral composition and grain-size into a number of categories, including "granite" and "dolerite" (called here "diabase" for the reasons indicated above. At this level, a detailed documentation of the characteristic of rocks is important (written descriptions, samples, photographs, etc.) for detailed classification at a later date. This is the first level of the hierarchy, where root names are applied.

In level 6, *gneisses* are divided into two subgroups, *migmatitic gneisses* and *(non-migmatitic) gneisses*, and whereas the root names for the igneous rocks remain unchanged (see level 5) or an attempt is made to differentiate different sub-types on the basis of field-determined mineral composition (i.e. into true *granites, granodiorites, tonalites, etc.*). Again, at this level, a detailed documentation of the characteristic of rocks is important for any further classification, but it is also noted that in this level, the scale of the observation is highly important as the structure of migmatitic gneisses can only be defined on outcrop-scale.

Level 7 is the end product of the classification system (for Olkiluoto, shown in Fig. 1) and at this level a certain amount of expertise on the nomenclature, as well as site-specific geological knowledge is required of the user. As in previous levels, the classification procedure should be documented carefully for transparency.

5 FUTURE MODIFICATIONS TO THE NOMENCLATURE

As was stated in the Introduction, changes to the nomenclature should be allowed, if necessary, but the changes should be documented carefully and proper justifications to the changes should also be made. Appropriate reference to older equivalent names should also be given (e.g. *diatexitic gneisses*, which were previously named as *mica gneiss migmatites*).

The main changes, which may be necessary in the current classification scheme, will arise from the use of different qualifiers and levels of hierarchy. For example, in future it may turn out that there is not actually any practical reason (from the perspective of construction and long-term safety) to distinguish between different migmatitic structures and therefore the level 6 term *migmatitic gneiss* may be an adequate term to describe the properties of these rocks, without subdividing further. Similarly, as another example, it is also possible that a more detailed level of description is needed for the TGG gneisses in future and therefore a hierarchical level 8 needs to implemented into the system, corresponding to TGG gneiss subgroups *tonalitic gneisses*, *granodioritic gneisses* and *granitic gneisses*. These examples also demonstrate the power and flexibility in the use of hierarchical systems – any increase or decrease in the level of information can be easily traced and a proper level of information can always be selected. Still, it should be noted that any increase in the hierarchical level of any classification system is also reflected in an increase in the amount of terms; therefore, a practical level, corresponding to the needs of the specific goal of the study, should be maintained.

For the implementation of new root names or qualifier terms, the consistency of the new terms should be checked against the BGS rock classification scheme and its recommendations.

6 CORRELATION TO OLD ROCK NAMES

A wide variety of names have been use for the rocks of Olkiluoto and in the following table (Table 1) rock names used earlier are compared with the new nomenclature presented in this report. The main changes are related to the nomenclature of migmatitic rocks, which, for instance, have been previously called “migmatitic mica gneisses” and “migmatites”, and subdivided into “dyke”, “veined” and “mica gneiss migmatites”, “stromatic migmatites”, “vein migmatites” and “diatexites”. A major change also concerns the TGG gneisses, which have been previously called “grey gneisses” and “tonalitic gneisses”. Mica and mafic gneisses and diabases have retained their names from the older classification schemes.

Table 1. *Comparison of old rock names to the current nomenclature*

BEDROCK MODEL 2003/1 (Vaittinen et al. 2003)	OTHER NAMES USED IN VARIOUS PUBLICATIONS	CURRENT NOMENCLATURE
Migmatitic mica gneiss	Migmatite	Migmatitic gneiss
Dyke migmatite	Stromatic migmatite	Stromatic gneiss
Veined migmatite	Vein migmatite	Veined gneiss
Mica gneiss migmatite	Diatexite	Diatexitic gneiss
Mica gneiss		**Mica gneiss**
Mafic gneiss		**Mafic gneiss**
Quartz-feldspar gneiss	Quartzitic gneiss	Quartz gneiss
Grey gneiss	Tonalitic gneiss	TGG gneiss
Granite pegmatite		Pegmatitic granite
Diabase		**Diabase**
	Granitic grey gneiss	K-Feldspar porphyry

SUMMARY

Due to international interest in the Finnish deep repository project at Olkiluoto (SW Finland) and the need for collaboration between scientists involved in site investigations for the disposal of spent nuclear fuel in other countries, a well-documented system of rock nomenclature is required, based on existing classification schemes and international recommendations. IUGS (International Union of Geological Sciences) and its subcommissions are currently working towards the establishment of unified terminology and classification of rock types. However, the work is far from ready and so far the IUGS has only produced general principles and recommendations on the use of terms. The process of introducing a comprehensive classification system is still some time in the future. The BGS (British Geological Survey) rock classification scheme is the most comprehensive of existing rock classification schemes and the basic principles behind it are utilised to the system of nomenclature for rocks in Olkiluoto. The BGS classification system is based on the use of descriptive names and a clearly defined hierarchy, making it possible to classify rocks at different levels depending on the specific goals of a study, the level of available information, and the expertise of the user. Each rock type is assigned a *root name*, which is based on structural and textural characteristics or the visually estimated modal composition of the rock. In addition, root names can be refined with adjectival *qualifier terms*. Qualifier terms refer to the structure or modal composition of the rock.

The root name for metamorphic rocks in Olkiluoto is, based on textural characteristics, *gneiss*. These are subdivided in a first step into migmatitic gneisses and (non-migmatitic) gneisses, which are further divided according to their structural characteristics and modal compositions: migmatitic gneisses into stromatic, veined, diatexitic gneisses, and (non-migmatitic) gneisses into mica, quartz, mafic and TGG gneisses. Root names for igneous rocks are granite, porphyry and diabases and granites can be further refined with textural qualifier term pegmatitic and porphyry with mineralogical qualifier term K-feldspar. The root name diabase for fine to medium grained rocks of basaltic composition is retained, in spite of being disfavoured by BGS (preferred term: dolerite), because it is in wide usage throughout Finland.

Changes to the proposed nomenclature are allowed, if necessary, but the changes should be documented carefully and proper justifications to the changes should also be made; appropriate reference to older equivalent names should also be given (e.g. *diatexitic gneisses*, which were previously named as *mica gneiss migmatites*). For the implementation of new root names or qualifier terms, the consistency of the new terms should be checked against the BGS rock classification scheme and its recommendations.

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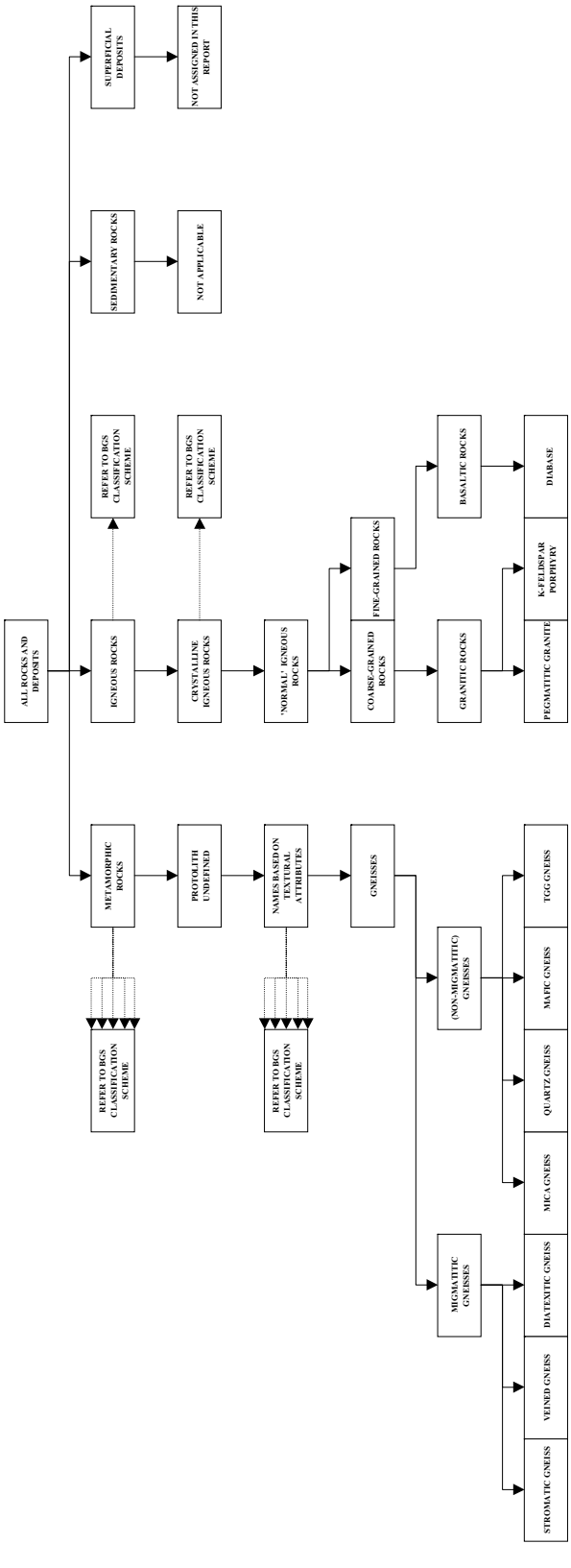
APPENDIX 1



Appendix 1. *Hierachical system of nomenclature for rocks at Olkiluoto, modified after Gillespie & Styles (1999) and Robertson (1999).*