

Towards a unified nomenclature of metamorphic petrology:

6. Migmatites and related rocks

A proposal on behalf of the IUGS Subcommittee on the Systematics of Metamorphic Rocks. Web version of 31.07.2002

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ABSTRACT

This paper presents the provisional results of the IUGS Subcommittee on the Systematics of Metamorphic Rocks in respect of migmatites, related rocks and associated processes. Comments on these proposed definitions are welcome.

INTRODUCTION

The Subcommittee for the nomenclature of Metamorphic Rocks (SCMR), a branch of the IUGS Commission on the Systematics in Petrology, was initiated in 1985 under the chairmanship of Rolf SCHMID (succeeded in 2001 by Douglas FETTES). The Subcommittee consisted initially of 31 members, distributed in 11 Study Groups devoted to special topics, and a Working Group of more than 100 earth scientists spread worldwide. The main work of the Subcommittee was done during annual or biennial working meetings and by correspondence. This main discussion phase of the Subcommittee's task is now complete and emphasis is currently being placed on publishing its recommendations.

The SCMR aims to publish international recommendations on how metamorphic rocks and processes are to be defined and named, as was previously done for igneous rocks by the Subcommittee on the Systematics of Igneous Rocks (LE MAITRE, 1989). The principles used by the SCMR for defining and classifying metamorphic rocks are outlined in SCHMID et al. (2002).

A special Study Group under the leadership of W WIMMENAUER was set up to look at the nomenclature of migmatites and related rocks. In addition to that small group, a number of worldwide specialists was consulted on their views on the more important terms being considered. Their answers were greatly appreciated and provided valuable contributions to the deliberations. This paper presents the definitions together with some notes explaining the reasoning.

In the discussions it turned out that the definition of migmatites and their subgroups is not an easy task. H. ROSENBUSCH's statement: "The essence of rocks is transition" is particularly valid for the migmatites. They form, in their total spectrum, a continuous transition from metamorphic to plutonic rocks. The establishment of limits within such a continuum is very difficult and the application of quantitative criteria virtually impossible. Thus, many of the 'definitions' presented below are characterisations of certain prominent rock types rather than definitions *sensu stricto*. Their application to a natural rock will often demand some scientific experience.

It should also be noted that the scale of migmatite structures is such that they mainly require definitions, which refer to rock masses greater than the preferred hand specimen size

The work was greatly facilitated by the existence of two comprehensive glossaries of terms bearing on migmatites, viz. DIETRICH & MEHNERT (1961), and MEHNERT (1968).

The definitions are classified in the following categories¹:

a) *Main terms*: well established throughout the world, by which the whole variety of metamorphic rocks or processes can be described without leaving gaps.

b) *Special terms*, fairly well established at least in parts of the world, which can be applied to varieties or less frequently occurring types of the major rock groups or processes, helping to diminish extensive description of such rocks or processes.

c) *Rarely or only locally used terms*, which, however, cannot be replaced by a short description using terms of categories (a) and (b). It will be recommended not to use such terms in papers appearing in international journals without repeating their definition.

d) *Obsolete terms*, which were not used in the last decades.

On the following pages, the definitions proposed by the SCMR are presented in italics; where appropriate, some comments on the reasoning leading to them are added.

DEFINITIONS OF TERMS

Migmatite (Category a)

A composite silicate rock, pervasively heterogeneous on a meso- to megascopic scale. It typically consists of darker and lighter parts. The darker parts usually exhibit features of metamorphic rocks while the lighter parts are of plutonic appearance (see also leucosome, melanosome, mesosome, neosome, paleosome). Wherever minerals other than silicates and quartz are substantially involved, it should be explicitly mentioned.

The essential elements of the above definition received wide approval from the Working Group. The last sentence makes allowance for the comments of some contributors who pointed out that migmatitic structures, as described in the definition, may also occur in non-silicate rocks. For the sake of clearness and simplicity, other versions of the definition, which might also cover very rare and uncommon varieties of migmatites, were eventually abandoned

Anatexis (Category a)

Melting of a rock.

The term is used irrespective of the proportion of melt formed, which may be indicated by adjectives such as *initial, advanced, partial, differential, selective, complete, etc.*

Migmatization (Category b)

Process of formation of a migmatite.

¹ This paper was written with a fourfold division of terms whereas the overall SCMR scheme uses a threefold categorisation (SCHMID et al., 2002, fig. 1). Categories (a) and (b) in this paper equate to the 'recommended rock names' category of the general SCMR scheme, category (c) to the 'restricted rock names' and category (d) to the 'unnecessary rock names'

Leucosome (Category b)

The lightest parts of a migmatite

Mesosome (Category b)

Rock portion in a migmatite, intermediate in colour between leucosome and melanosome. If present, the mesosome is mostly a more or less unmodified remnant of the parent rock (protolith) of the migmatite.

In spite of the near-identity of most mesosomes with the paleosome, a purely descriptive term for the intermediate parts of a migmatite appeared desirable.

Melanosome (Category b)

The darkest parts of a migmatite, usually with prevailing dark minerals. It occurs between two leucosomes or, if remnants of the more or less unmodified parent rock (mesosome) are still present, it is arranged in rims around these remnants.

Paleosome (Category b)

Part of a migmatite representing the parent rock (cf. mesosome).

Neosome (Category b)

The newly formed parts of a migmatite (metatects and restites).

Restite (Category b)

Remnant of a metamorphic rock from which a substantial amount of the more mobile components have been extracted without being replaced.

Resister (Category b)

Rock offering greater resistance to granitization than another by virtue of its composition or its 'impenetrable' fabric.

While 'restites' are rock portions, which have undergone essential changes of their earlier composition, 'resisters' are rocks, which have survived the formation of the surrounding migmatite (or granite) without significant changes to their mineralogical and chemical composition. Although the term 'resister' is not widely used, MEHNERT's definition is proposed here as a category b term. Its meaning is not easily replaced by another, more frequently used term.

A few members of the Working Group would like to confine the definition to crustal processes, but we believe that it should also be applicable to mantle processes.

Anatexite (Category b)

Two versions of the definition have been discussed in the Subcommittee; the first one (a, below) has been preferred because the second version could be applied to any magmatic rock believed to be of anatexitic origin.

a) *Rock still showing the evidence of in-situ formation by anatexis.*

b) Any rock showing structural and/or compositional evidence of formation by anatexis.

Metatexis (Category b)

Initial stage of anatexis where the parent rock (paleosome) has been partly split into a more mobile part (metatect) and a non-mobilised (depleted) restite (cf. paleosome, metatect, restite).

Metatexite (Category b)

A variety of migmatite with discrete leucosomes, mesosomes, and melanosomes (cf. leucosome, mesosome, melanosome).

Although the term refers directly to the genetic term ‘metatexis’, a descriptive definition of the rock type is also required.

Metatect (Category b)

Discrete, mostly light-coloured body in a migmatite formed by metatexis.

Arterite (Category b)

A variety of migmatite where the darker parts are injected by veins of lighter material (leucosomes) introduced from outside.

Wherever the introduced material is not lighter than the surrounding rock, it should be explicitly mentioned.

Venite (Category b)

A variety of migmatite in which the material of the lighter veins (leucosomes) is extracted from the parent rock.

As with ‘arterite’, the definition is explicitly a genetic one. As a non-genetic name for veined rocks, SCHEUMANN's ‘phlebite’ might be used (see below).

Phlebite (Category b)

A veined rock; the veins may have been injected from outside or exuded in situ.

Diatexis (Category b)

Advanced stage of anatexis where the dark-coloured minerals are also involved in melting. The melt formed has not been removed from its place of origin (cf. metatexis).

Diatexite (Category b)

A variety of migmatite where the darker and the lighter parts form schlieren and nebulitic structures which merge into one another (cf. diatexis).

Although the term refers directly to the genetic term ‘diatexis’, a descriptive definition of the rock type is also required.

Nebulite (Category b)

Migmatite with diffuse relics of pre-existing rocks or rock structures.

Agmatite (Category b)

Migmatite with breccia-like structure.

Palimpsest structure (Category b)

Structure in a migmatite or granitized rock, which can be recognized as pre-migmatitic (or pre-granitic).

Definition of MEHNERT (1968) unchanged.

Palingenesis (Category b)

Formation of a new magma by complete or nearly complete melting of pre-existing rocks.

Granitization (Category b)

A comprehensive term for processes by which pre-existing rocks are converted to granitoids (melting, pervasive influx of chemical components such as SiO_2 , K_2O , Na_2O or other means of pervasive transformation).

79% of the answers from of the worldwide Working Group to the questionnaire agreed that the term should be defined. Some contributors proposed to abolish the term, but it is widely used, comprehensive, and cannot be replaced by a better one. Some suggested that the term should be restricted to metasomatic processes. However, we consider the term to have a general meaning, and special cases can easily be specified by an appropriate adjective (e. g. metasomatic granitization, anatectic granitization).

Degranitization (Category b)

A process by which a rock is depleted in chemical components which are significant in making up a granitoid, essentially SiO_2 , K_2O +/- Na_2O .

Several members of the Working Group proposed to abolish the term. However, it has been used since 1955 and designates a process demonstrated in several well-studied areas, for example, the granulites of the Ivrea Zone and Calabria.

Feldspathization (Category b)

Formation of feldspar, due to metasomatism.

Metablastesis (Category b)

Preferred crystallization and growth in size of a mineral or a group of minerals by metamorphic (including metasomatic) processes.

‘Preferred’ is used to emphasize the fact that certain minerals grow to larger sizes than others.

Metamorphic differentiation (Category b)

Mechanical redistribution of minerals by species and/or segregation of chemical components during metamorphism to form an inhomogeneous structure of two or more species within a rock body.

The wording: "to form an inhomogeneous structure." was chosen because redistribution may also result in forming a more homogeneous body. Particular attention was given to the distinction of ‘redistribution’ of solid minerals and ‘segregation’ of chemical components, transported in solution.

Ptygmatic folding (proposed for category b)

Two definitions are still open for discussion:

a) *Form of folded veins in migmatites characterised by complex flowing phenomena and the absence of shearing planes* (MEHNERT 1968, p. 356).

b) *Form of folded veins in migmatites caused by the processes to which the migmatites owe their origin and composite character* (TOMKEIEFF 1987, p. 469).

A number of other terms pertaining to migmatites or related rocks (and processes) have been considered by the Study Group. They appear to be candidates for the categories c (rarely or only locally used terms) and d (obsolete terms). **They are listed below and the readers of this paper are asked for their opinion about their classification.** In any case, the terms will be presented in the final glossary and their original (and further) definitions will be quoted there.

Akyriosome, akyrosome, allomigmatite, anamigmatization, aorite, atectite, atexite, automigmatite, chorismite (exochorismite, endochorismite), chymogenetic, crocydite, deuterite, diabrochite, diabrochomorphism, diachyte, diadysite, dictyonite, dictyonitic structure, educt, ektexis (or ectexis), embrechtite, entexis, epibolite, hybrid gneiss, ichor, imbibition, kyriosome, lipotectite, lipotexite, lit-par-lit injection, merismite, metasome, metasost, metaster, metatectite, mianthite, mictite, mictosite, migma, mixto-gneiss, ophthalmite, penetration metamorphism, polymigmatite, plutonic metamorphism, plutometamorphism, rheomorphism, skialith, stereogenic, stereogenetic, stereosome, stictolite, stromatite, surreite structure, syntexis, syntexite, treptomorphism, ultrametamorphism.

CONCLUDING REMARKS

In earlier questionnaires the members of the SCMR Working Group were asked if they used certain terms or not, among them terms in the migmatite field. The answers were very informative, but it may be supposed that many of those who answered did not have direct experience of naming elements or varieties of migmatites in the field or teaching. From their long experience in mapping and describing migmatites, the members of the Study Group feel that the terms now classified in categories a and b are useful and even necessary, including rather new ones like 'mesosome'. They believe that the terms defined above are the minimum required to describe and classify common natural phenomena and well-known processes. In this sense, the SCMR proposes the definitions now presented for general acceptance. Possibly, some of the terms preliminarily classified in categories c and d may still be recommended for promotion in category b.

Any specific comments on migmatite terminology are encouraged and should be sent to I BRYHNI (inge.bryhni@toyen.uio.no)

ACKNOWLEDGEMENTS

Apart from the members of the Subcommittee and those members of the Working Group who answered the questionnaires, the following colleagues participated by correspondence to the discussion: J. R. ASHWORTH (Birmingham, U. K.), W. JOHANNES (Hannover, Germany), Mrs. O. MATEJOVSKA (Prague, Czech Rep.), K. R. MEHNERT (Berlin, Germany), J. MICHOT (Brussels, Belgium), K. A. SHURKIN (Moscow, Russia), R. J. TRACY (Blacksburg, Va., USA). Their contributions are gratefully acknowledged.

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