

2.11: Stratigraphic nomenclature

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Stratigraphy (stratum [Latin] = blanket, layer; graphein [Greek] = to write) is a geological discipline that originally dealt with the description of rocks in the widest sense. As geology became subdivided into more and more specialized subdisciplines, the use of the term 'stratigraphy' came to be restricted in practice to the description and analysis of the horizontal and vertical relationships between rock units and their age relationships. This 'modern' usage is followed here.

Stratigraphic nomenclature, in this sense, deals with the names given to specific rock units and the time during which they were formed. These so-called stratigraphic units may be distinguished by several variables. By far the most common variables are lithology (rock type: lithos [Greek] = stone), fossil content, and age. Classification by these variables results in, respectively, lithostratigraphic units (each with its lithostratigraphic name), biostratigraphic (bios [Greek] = life) units (each with its biostratigraphic name), and chronostratigraphic (chronos [Greek] = time) units (each with its chronostratigraphic name).

In the course of time, numerous other variables have been found useful for stratigraphic purposes – sometimes on only a local scale and sometimes on a global scale. Some examples of these variables are inversions of the Earth's magnetic field (magnetostratigraphy), the successive occurrences of fossil (i.e. buried) soils (pedostratigraphy: pedon [Greek] = ground, soil), the relative intensity of radiation (for example, neutron-log stratigraphy), and the occurrence of specific minerals (for example, zircon-type stratigraphy). In The Netherlands, a local form of stratigraphy – pipe-bowl stratigraphy – has developed in the past few centuries, based on broken stone pipes that had been thrown overboard by sailors and became embedded in the accumulating sediments of lakes, coastal waters, and the central lagoon (Zuiderzee area).

All types of stratigraphy – but lithostratigraphy, biostratigraphy, and chronostratigraphy in particular – should preferably follow the rules and principles of stratigraphic nomenclature. The following sections will deal only with these three main types of stratigraphy and are based on the rules laid down in the *International Stratigraphic Guide* (Salvador 1994).¹ It is important to note that the nomenclature for each of these three types of stratigraphy is different and follows different rules.

It is impossible within the context of this Handbook chapter to detail all aspects of stratigraphic nomenclature, so only the topics that are most important for scientific editors are mentioned here. The data provided are sufficient for those editors who occasionally edit geological texts that

do not have a specialist stratigraphic character. Editors of texts in stratigraphy or palaeontology should use the latest edition of the *International Stratigraphic Guide*.¹

A guide, not a code

The *International Stratigraphic Guide* (subsequently called the Guide) is not a code like the International Zoological and Botanical Codes, which prescribe rules. It states explicitly (p. xv)¹: "No individual, organization, or nation should feel constrained to follow it, or any part of it, unless convinced of its logic and value. The I[n]ternational S[ub]commission on S[tratigraphic] C[lassification] still believes that matters of stratigraphic classification, terminology, and procedure should not be legislated. The purpose of the Guide is to inform, to suggest, and to recommend". This gives freedom to editors, but they should obviously try to make a text as unambiguous as possible by using well-defined and generally recognized terms.

Stratigraphic units

As stratigraphic nomenclature deals with the terminology used to define stratigraphic units, it is important that the use of such units be unambiguous and consistent with common practice.

According to the first stratigraphic guide (Hedberg 1976)², a stratigraphic unit is "a stratum or assemblage of adjacent strata recognized as a unit (distinct entity) in the classification of the Earth's rock sequence, with respect to any of the many characters, properties, or attributes that rocks possess. Stratigraphic units based on one character will not necessarily coincide with those based on another; it is therefore essential that different terms be used for each so that their named units can be distinguished from each other. Clear definition of a stratigraphic unit is of paramount importance".

Stratigraphic units may be used in a formal or an informal way. If used formally, the units should be defined and named in an unambiguous way, preferably according to rules presented in the Guide.¹ The most important aspects that should be dealt with when a new formal stratigraphic unit is described are: the name; the kind (litho-, bio-, or chronostratigraphic) and rank (high or low in the hierarchical order); the stratotype (i.e. the designated rock section representing the particular unit) and/or type locality; and the correlation or relation with other units. In addition, it should be stated whether the unit (or part of it) has been described and named previously in the same kind of stratigraphy, and why it is considered useful to establish a new unit. For more details, and for additional aspects

that may have to be dealt with, readers should refer to the Guide.¹

Stratigraphic units may also be used in an informal way (i.e. in a loose sense for example, because this is more useful locally or because a formal description of the unit is not yet ready). Such units need not be defined properly, but it is nevertheless advisable in such cases to adhere to the rules of nomenclature presented in the Guide.¹

The formal or informal character of a unit should be expressed in the spelling of its name (most commonly, informal names should be written without the initial capitals that should be used for formal units). The recommended differences between the terminologies for formal and informal units will be indicated in the following sections, wherever appropriate.

Lithostratigraphic units

Lithostratigraphic units are differentiated according to their types of rock (sandstone, granite, etc.). Lithostratigraphy can be applied to sedimentary, igneous, and metamorphic rocks or a combination of these, but it is used most commonly for stratigraphic studies concerning sedimentary rocks. The essential characteristic is a lithology that is different from that of the adjacent lithostratigraphic units (for example, a sandstone unit intercalated between shales, or a limestone unit with a number of volcanic ash layers intercalated between limestones without ash layers). There is currently an unfortunate tendency to differentiate between lithostratigraphic units on the basis of characteristics that can be analysed properly only in a laboratory (heavy-mineral assemblages, ¹²C:¹⁴C ratio, etc.), but this is not advisable: only major lithological features readily recognizable in the field (for example, fine-grained sandstone, black shale, poorly rounded gravel, coral limestone) should serve as the basis for lithological units.

The most fundamental lithostratigraphic unit is the formation. Each stratigraphic column should, if subdivided on a lithostratigraphic basis, consist of at least one formation. Formations may be subdivided into lower-rank units and/or be combined into a higher-rank unit. The ranking (in hierarchical order) is group, formation, member, and bed (these terms are written with lower-case initial letters, unless they are part of a formal stratigraphic name: see the next two paragraphs). The number of ranks can, if required, be increased by the addition of superunits (for example, a supergroup) or subunits (for example, a subformation). This, however, is not advisable because the differences between formal and informal units may become vague.

The naming of each type of lithostratigraphic unit follows specific rules. Each name should have a geographical component and a rank component; a lithological component may be added but is rarely necessary. For formal units, all components should be written with an initial capital (for example, the Barranquito Member of the Tejerina Formation). For informal units, only the geographical component should be capitalized (for example, Prioro flysch formation) and the rank may be omitted (for example, upper Pando sandstone).

The geographical component should be the name of a geographical feature (lake, hill, city, tower, etc.) where, or near which, the unit shows its typical lithology; it must not be identical with a name used for another unit of any rank. The geographical component after which the unit is named should preferably be found on a published map, though not necessarily a recent one. (Note that Google maps may be sufficient – although not all parts of the Earth have been mapped by Google – however a map from a quality agency such as the Ordnance Survey is preferable.) The spelling should be consistent with the usage in the area where the geographical feature is situated. The disappearance of this feature, or a change in its spelling, should not be followed by a change in the name or spelling of the name of the lithostratigraphic unit.

It is not possible to distinguish formal units that are not primarily based on the presence of a formal formation. Formal beds can be distinguished only within formal members. It is possible to distinguish informal units within a formal (higher-ranked) unit (for example, the trilobite shale zone within the Mesao Limestone Member) or within an informal (higher-ranked) unit (for example, the basal conglomerate in the upper Pando sandstone), but the reverse (a formal unit within an informal one) is not allowed. The lithological component, if used, should be as simple as possible. 'Limestone' is to be preferred over 'Marly Limestone' or 'Limestone-Marl-Limestone', even if these last two terms are lithologically more correct. Terms that are sometimes used in a lithological manner but that are in fact interpretative should be avoided; a common example is the use of the term 'till' (for a deposit consisting of a boulder/sand/mud mixture deposited by glaciers) where the descriptive lithological term 'diamicton' or 'boulder clay' should be used.

With respect to the lithological component, it should be remembered that lithostratigraphic units may change their character both laterally and vertically. This is one reason it is generally not considered useful to include a lithological component in a unit's name. Another reason is that future research (for example, subsurface or offshore) may reveal lithological characteristics that are different from the ones currently known; the overall characteristics may nevertheless be so similar that it is logical and useful to attribute the newfound rocks to the previously defined unit.

Biostratigraphic units

Whereas lithostratigraphic nomenclature applies to all types of rock, biostratigraphic nomenclature is restricted to sedimentary rocks. Biostratigraphic units are distinguished by their fossil content. Each specific content of fossil species (or any other rank of fossils) in a succession (that is, an originally vertical pile of rocks formed by ongoing deposition of sediments) may be used to distinguish such a succession as a separate unit, termed 'biozone'. Barren successions intercalated between two successive biozones are termed 'barren interzones'; if they are found within a biozone, they are termed 'barren intrazones'.

Biozones may, like lithostratigraphic units, be combined

into superbiozones (also termed 'superzones') or be subdivided into subbiozones ('subzones'). There are five general types of biozones: assemblage zones (based on the presence of a natural assemblage of fossils), range zones (determined by the stratigraphic range of a selected fossil), abundance zones (previously termed 'acme zones'; these are based on the relative abundance or development of certain fossils), lineage zones (representing a specific segment of an evolutionary lineage) and interval zones (also termed 'interbiohorizon zones', which represent a stratigraphic interval between two biohorizons). Readers should refer to the Guide¹ for details about establishing and defining the various types of biozones.

The name of any formal biostratigraphic unit should consist of the name (or names) of the relevant fossil (or fossils) followed by the term 'Zone' (with a capital letter Z) or by the name of the type of biozone (for example, *Fusulinella* Zone and *Exusalbus* Assemblage-zone).

The name(s) of the fossil(s) should be written as prescribed by the rules of nomenclature for zoology,^{3,4} botany⁵ or bacteriology.⁶ The author's name of a species and the year of publication of the first description of the species should not, however, be included. The fossils chosen for the name of the zone may represent any taxon (class, variety of a subspecies, etc.), depending on the usefulness for the biostratigraphic subdivision; the use of specific (and subspecific) names is advised. For an assemblage-zone, it is not necessary to mention all relevant fossil names in the name of the zone: it is best to use the most characteristic one (see the above example of the *Exusalbus* Assemblage-zone) and avoid almost unreadable names, such as '*Globorotalia (Turborotalia) acostaensisacostaensis* – *Globorotalia (G.) merotumida* Partial-range-zone'.

The type of zone need not be detailed if there is no specific reason to do so: it may be sufficient to term the unit, for instance, '*Linopteris obliqua* Zone'. The word 'Zone' should have an initial capital if the biostratigraphic unit is used formally; when used informally, the word 'zone' should be written with a lower-case initial. If a specific type of biozone is detailed (for example, *Exusalbus* Assemblage-zone), the initial letter of the type of zone should be capitalized; a hyphen should be used between 'Assemblage' and 'zone'; and the word 'zone' should, in this case, be written with a lower-case letter. If the unit's name is used informally, the initial letter of the specific type of zone should be in lower-case (for example, *Fusulinella-Beedeina-Fusiella* assemblage-zone).

Hyphens should also be used when a subdivision of a specific type of zone is indicated (for example, *Fusulinella* Partial-range-zone). For a formal unit, only the first initial should be capitalized; in informal units, no capitals should be used.

In contrast to the situation with lithostratigraphic units, the names of biostratigraphic units should be adapted to conform to changes in names of taxa required by the international codes of zoological and botanical nomenclature.

Chronostratigraphic units

Chronostratigraphic units are rock units that represent a specific interval of geological time. The distinction of chronostratigraphic units is particularly useful for age correlation of rocks. Various ranks of chronostratigraphic units exist, and their hierarchical order is eonothem (written with a lower-case initial except when used as part of a formal chronostratigraphic unit, such as the 'Phanerozoic Eonothem'); erathem (for example, the Cenozoic Erathem); system (for example, the Quaternary System); series (for example, the Pleistocene Series); stage (for example, the Weichselian Stage); and (rarely used) substage (for example, the Late Weichselian Substage). It should be noted that the term 'substage' used in the second edition of the Guide¹ replaces the term 'chronozone' used in the first edition² the second edition considers 'chronozone' to be a non-hierarchical, informal term. The various units, though preferably only the system and the series, may be extended with higher-order units (indicated by the prefix 'super') and with lower-order units (indicated by the prefix 'sub'). The rank of substage, as a replacement for 'chronozone', should obviously not be extended with the prefix 'super' or 'sub'.

Formal chronostratigraphic units should have a binomial name: a proper name plus a term indicating the rank. Both words should have capitalized initials. In practice, the rank name is often deleted ('Cretaceous' instead of 'Cretaceous System'), but this should be avoided because confusion can then easily arise with geochronological units (see the next section). When chronostratigraphic units are formally subdivided (for example, the Lower, Middle, and Upper Jurassic Series), the terms 'Lower', 'Middle' and 'Upper' should be written with an initial capital; if the age of a specific rock unit is not known in sufficient detail, lower-case letters should be used (for example, upper Jurassic series), thus indicating that the rock unit is situated physically in the upper part of a Jurassic succession but that whether it dates from the beginning, the middle, or the end of the Jurassic Period is not known.

Geochronological nomenclature

A study of the literature leads to the conclusion that few authors – and apparently far too few editors – are aware of the differences between chronostratigraphic and geochronological nomenclature. Whereas the first deals with rock units (formed within a specific time), the second deals with time (during which specific rocks were formed).

The way the geological timescale is subdivided forms the basis for chronostratigraphic subdivision. This implies that each chronostratigraphic term has a geochronological equivalent from which it was derived. It also implies that the hierarchical ranking of chronostratigraphy has a geochronological counterpart. The geochronological hierarchy is as follows (with the chronostratigraphic counterpart in parentheses): eon (eonothem), era (erathem), period (system), epoch (series), age (stage), and subage (substage). Periods, epochs, and ages can be extended (the prefixes 'super' and 'sub' can be used, as in chronostratigraphy).

The names of the various geochronological units are almost always identical to those of their chronostratigraphic counterparts (for example, the counterpart of the Weichselian Stage is the Weichselian Age – the latest ice age). The only exceptions are the terms ‘Lower’ and ‘Upper’ in chronostratigraphy: they are replaced by ‘Early’ and ‘Late’ in geochronology. For example, a succession of rocks belonging to the Lower Cretaceous Series consists of rocks that were formed during the Early Cretaceous Epoch; fossils from an Upper Jurassic succession date from the Late Jurassic.

The hierarchical rank is rarely mentioned in geochronology but is sometimes required to avoid confusion. The term ‘Mesozoic’ thus usually indicates the Mesozoic Era, not the Mesozoic Erathem. The similar names, and the fact that the rank is usually not mentioned in geochronology, underlines the importance of mentioning the rank term in chronostratigraphy.

References

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Further reading

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