# Guidance on Geologic Names Usage for Authors and Peer Reviewers of Geologic Maps and Reports—A Primer on Stratigraphic Nomenclature

By Randall C. Orndorff

Chapter D of
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# Chapter D

# Guidance on Geologic Names Usage for Authors and Peer Reviewers of Geologic Maps and Reports—A Primer on Stratigraphic Nomenclature

By Randall C. Orndorff

## Introduction

Consistent and effective communication is essential for scientific publications. Scientific communication requires clear explanations and precise discussion of data and interpretations.

> "Authors must strive for clarity, consistency, and correct usage of both formal and informal terminology because of the complex interactions between time and space interpreted from the presently existing stratigraphic record" (Owen, 2009).

The importance of consistent stratigraphic nomenclature as a means of effective geologic communication has been recognized since the U.S. Geological Survey (USGS) established the Geologic Names Committee (GNC) in 1899 to evaluate and address issues of stratigraphic nomenclature. The GNC currently consists of geologists from the USGS and the Association of American State Geologists.

In an effort towards codifying stratigraphic nomenclature, the North American Commission on Stratigraphic Nomenclature developed the North American Stratigraphic Code (referred to hereafter as "the Code"; North American Commission on Stratigraphic Nomenclature [NACSN], 2021) in 1983 by revising and updating preexisting codes that were then in use, such as the International Stratigraphic Guide [ISG] (International Subcommission on Stratigraphic Classification [ISSC], 1976; see also, ISSC, 1994).

Consistency in geologic names usage increases accuracy and quality of scientific publications. All formal USGS publications require a geologic names review (GNR) if any stratigraphic, lithodemic, geochronologic, or chronostratigraphic terminology is used. This review of, and guidance for, geologic names usage and stratigraphic principles should be referred to by authors and peer reviewers, not just those who conduct GNRs, and its guidance should be incorporated into their publications to improve geoscience communication. The notes and guidance in the sections that follow should be considered by USGS geologists and editors while writing or reviewing manuscripts that include geologic names and stratigraphic concepts. This primer may also be used by geologists and editors outside of the USGS for consistency with their publications.

## Why Geologic Names (and Geologic Names Reviews) are Important

A geologic names review is an important part of producing and publishing a geologic map—it involves much more than spell checking geologic names and correcting usage of rank and rank terms. It also includes making sure publications are in conformance with the Code (NACSN, 2021) or the ISG (ISSC, 1994). It also is important to help make sure that stratigraphic consistency is maintained between the discussion, Correlation of Map Units (CMU), Descriptions of Map Units (DMU), and Lists of Map Units (LMU), as well as between figures and tables in reports and on geologic maps.

The standard database of geologic names and units for the United States and its territories, Geolex (https://ngmdb.usgs.gov/Geolex/), is an important resource for geologists to consult for current and historical nomenclature, age designations, and the areal extents of units. Many other resources (see appendix 1) may be consulted, and links to many of these resources can be found on the National Geologic Map Database (NGMDB) website, under Standards (https://ngmdb.usgs.gov/Info/standards/). The GNC periodically publishes an updated time scale that can be used when defining stratigraphy and using chronostratigraphic and geochronologic units (see, for example, Orndorff and others, 2023 [this volume]).

## Geologic Names and Ages—Important Things to Consider When Preparing a Geologic Map or Conducting a Geologic Names Review

Stratigraphic units can be either lithostratigraphic (geologic or material rock units such as groups, formations, and members), chronostratigraphic (time-material units or bodies of rock that follow the law of superposition), or geochronologic (nonmaterial or temporal units that are based on the divisions of geologic time). Each of these unit types is well defined in the Code (NACSN, 2021).

The following sections cover specific principles regarding temporal units and geologic or material rock units, as well as on geologic names and ages, that authors will need to consider as they define their stratigraphy on geologic maps or in reports. Editors and persons who are conducting GNRs will also need to consider these principles during their reviews.

## Temporal (Geochronologic or Time) and Chronostratigraphic (Position) Units

Geochronologic and chronostratigraphic units do not describe the lithology or stratigraphic ranking of geologic materials; rather, they communicate the relative ages or positions of deposits and rocks and the concepts of geologic time (that is, ages that are based on the divisions of geologic time). The meanings of these types of temporal and chronostratigraphic units are different, and care should be taken to use their correct terms.

### Position Versus Time

A common mistake authors make is mixing terms for position (lower and upper) and time (early and late). By convention, position (chronostratigraphic) terms are used when discussing or describing sedimentary rocks and deposits, and time (geochronologic) terms are used when discussing or describing ages of igneous rocks or events. Chronostratigraphic units can be equivalent in age to geochronologic units, but their terms are different. For example, the geochronologic unit Miocene Epoch is equivalent in age to the chronostratigraphic unit Miocene Series. Table 1 shows the hierarchy and terms of chronostratigraphic and geochronologic units used in some geologic time scales.

Exceptions to this convention are the ages of lithodemic units (that is, intrusive and high-grade metamorphic rocks), which do not follow the law of superposition. Geochronologic (time) terms are used when discussing or describing the ages of these types of rocks.

Fluvial-terrace deposits are another potentially confusing exception. Most geologic units, especially volcanic rocks, are numbered from oldest to youngest: the first (oldest) bed or lava flow in a series is numbered 1, and progressively younger beds or flows are numbered 2, 3, 4, and so on. However, fluvial-terrace deposits are deposited as stream systems downcut the topography (fig. 1); thus, the youngest deposits (Qt1 in fig. 1) in the first terrace appear on the landscape in the lowest position, and the oldest deposits (Qt3 in fig. 1) are in the highest position. Therefore, they typically are numbered from youngest to oldest. It is appropriate to use geochronologic (time) terms when discussing or describing the ages of fluvial-terrace deposits.

### Formally Named Chronostratigraphic and Geochronologic Units

All formally named chronostratigraphic units and their equivalent geochronologic units (that is, all eonothems [or eons], erathems [or eras], systems [or periods], series [or epochs], and stages [or ages]), as defined in the Code, are capitalized. Any chronostratigraphic or geochronologic unit listed in the current USGS time scale (Orndorff and others, 2023 [this volume]) is considered formal and, thus, is capitalized.

**Table 1.** Rank hierarchy of types of chronostratigraphic (position) terms and their equivalent geochronologic (time) terms, showing examples of their ages.

[Modified from Owen (2009)]

| Chronostratigraphic (position) term | Example of chronostratigraphic age | Geochronologic (time) term | Example of geochronologic age |
|---|---|---|---|
| Eonothem | Phanerozoic Eonothem | Eon | Phanerozoic Eon |
| Erathem | Cenozoic Erathem | Era | Cenozoic Era |
| System | Quaternary System | Period | Quaternary Period |
| Series | Pleistocene Series | Epoch | Pleistocene Epoch |
| Stage | Gelasian Stage | Age | Gelasian Age |

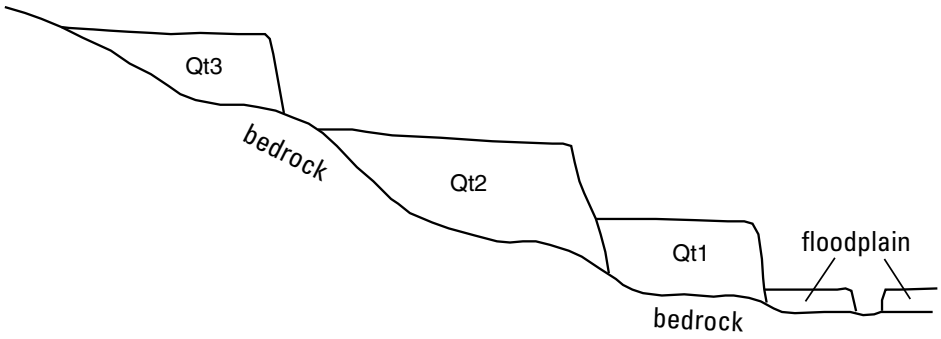


**Figure 1.** Diagrammatic cross section of fluvial landscape, showing relative positions of terrace deposits and their numbering from youngest to oldest (Qt1, Qt2, and Qt3, respectively).

## Formal Names for Series (or Epochs)

The Cenozoic Erathem (or Era) is divided into the Tertiary and Quaternary Systems (or Periods). The Tertiary is divided into the Paleogene and Neogene Subsystems (or Subperiods), and these are further subdivided into the following formally named series (or epochs): the Paleogene, into the Paleocene, Eocene, and Oligocene Series (or Epochs), and the Neogene, into the Miocene and Pliocene Series (or Epochs). The Quaternary is divided into the Pleistocene and Holocene Series (or Epochs).

The Paleozoic and Mesozoic Erathems (or Eras) are divided into systems and periods as well: the Paleozoic, into the Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Permian Systems (or Periods); and the Mesozoic, into the Triassic, Jurassic, and Cretaceous Systems (or Periods). Traditionally, these Paleozoic and Mesozoic Systems (or Periods) also have been divided into formally named series or epochs by adding "Lower" (or "Early"), "Middle," or "Upper" (or "Late") to the system or period name. However, the International Commission on Stratigraphy is currently (2023) in the process of replacing these added time and position terms with formal series and epoch names (Orndorff and others, 2023 [this volume]). As of this writing (2023), assigning formal series and epoch names to the Paleozoic and Mesozoic Systems (or Periods) has been completed only for the Silurian and Permian Systems (or Periods).

Table 2 lists the formally named temporal and chronostratigraphic units (that is, systems [or periods] and series [or epochs]) in the Paleozoic, Mesozoic, and Cenozoic Erathems (or Eras) used in geologic time scales and their currently accepted (formally named) time and position subdivisions.

**Table 2.** Formally named erathems (or eras), systems (or periods), and series (or epochs) and their currently accepted (formally named) age and position subdivisions.

[--, not applicable]

| Erathem or era | System or period | Currently accepted (formally named) series, epoch, position, or time subdivision | | |
|---|---|---|---|---|
| | | As a series or epoch | As a position subdivision | As a time subdivision |
| Cenozoic | Quaternary | Holocene<br>Pleistocene | -- | -- |
| | Tertiary | Pliocene<br>Miocene<br>Oligocene<br>Eocene<br>Paleocene | -- | -- |
| Mesozoic | Cretaceous | -- | Upper<br>Lower | Late<br>Early |
| | Jurassic | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |
| | Triassic | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |
| Paleozoic | Permian | Lopingian<br>Guadalupian<br>Cisuralian | -- | -- |
| | Pennsylvanian | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |
| | Mississippian | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |
| | Devonian | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |
| | Silurian | Pridoli<br>Ludlow<br>Wenlock<br>Llandovery | -- | -- |
| | Ordovician | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |
| | Cambrian | -- | Upper<br>Middle<br>Lower | Late<br>Middle<br>Early |

The term Precambrian has been used for many years to refer to the division of time that is older than the Phanerozoic Eonothem (or Eon). However, the GNC considers the term Precambrian to be informal and without specific stratigraphic rank (although it traditionally is capitalized). Thus, the term Precambrian should not be used in new geologic mapping when specifying ages older than the Phanerozoic Eonothem (or Eon); instead, the more accurate age divisions of the Proterozoic Eonothem (or Eon) such as the Mesoproterozoic Erathem (or Era) should be used.

## Informal Subdivisions of Series and Epochs

Sometimes it is necessary for authors to use terms that are either more detailed or more generalized than what is formally accepted when describing their geologic units. However, subdivisions of any chronologic or geochronologic unit not listed in table 2 are considered informal and, thus, are lowercased, as are all their time (late or early) and position (upper or lower) divisions. The following list contains examples of such informal usage:

- The late Quaternary is shorthand for the late part of the Quaternary Period
- The middle Miocene, for the middle part of the Miocene Series (or Epoch)
- The early Eocene, for the early part of the Eocene Epoch
- The upper Neogene, for the upper part of the Neogene Subsystem
- The lower Tertiary, for the lower part of the Tertiary System
- The Late Cretaceous, for late in the Cretaceous Period
- The early Silurian, for the early part of the Silurian Period
- The late Mesozoic, for the late part of the Mesozoic Era
- The upper Paleozoic, for the upper part of the Paleozoic Erathem
- The late Proterozoic, for the late part of the Proterozoic Eon

It is worth noting that the current USGS geologic time scale (Orndorff and others, 2023 [this volume]) shows only formally named subdivisions; thus, if a subdivision is not listed in the time scale, it is considered informal and should be lowercased.

## When Lithostratigraphic Units Span Chronostratigraphic or Geochronologic Units (Using "to" Versus "and" Versus "or")

A lithostratigraphic unit can be assigned to more than one chronostratigraphic or geochronologic unit. In these cases, the choice of conjunction is important, as the following rules and examples indicate:

- The term "to" should be used to mean relatively continuous deposition or time; for example, "Ordovician to Devonian" includes the Silurian
- The term "and" should be used to indicate that a significant amount of strata or time is missing; for example, "Ordovician and Devonian" excludes the Silurian
- The term "or" should be used to mean a single horizon of unknown age or one that has one age and cannot span time; for example, use "Ordovician or Silurian" when referring to a horizon of unknown age

# Lithostratigraphic Units

Lithostratigraphic units are the foundation for delineating bodies of rock and are recognized and defined by observable rock characteristics.

## Hierarchy of Lithostratigraphic Rank Terms

Rank terms of lithostratigraphic units must follow the hierarchy set forth in the Code (NACSN, 2021). Table 3 lists the types of lithostratigraphic units in the correct hierarchical order.

It is important to assign the correct lithostratigraphic rank to a parent geologic unit and its subunits by following the order shown in table 3. Note that the rank of a geologic unit cannot also be assigned to one of its subunits.

## Formal Versus Informal Geologic Unit Names—Uppercase Versus Lowercase

A sometimes confusing aspects of stratigraphic nomenclature is knowing when to capitalize names of geologic units and when to use lowercase. Simply stated—all words (other than articles) in formally named geologic units, as defined in the Code, are capitalized. This includes all formal lithostratigraphic names (that is, group, formation, and member names) that follow the Code. Conversely, all lithologic terms in informally named stratigraphic units are lowercased, as are their assigned lithostratigraphic-unit ranks (that is, member and submember names).

**Table 3.** Rank hierarchy of types of geologic (stratigraphic or lithodemic) units.

[Modified from Owen (2009). --, not applicable]

| Stratigraphic unit | Lithodemic unit |
|---|---|
| Supergroup | Supersuite |
| Group | Suite |
| Formation | Complex |
| Member | -- |
| Submember | -- |
| Bed, flow, tongue | -- |

When using or determining formal versus informal geologic unit names, authors should first consult Geolex (https://ngmdb.usgs.gov/Geolex/) to find out if a name already has formal designation. If you are mapping a formally named unit, it is important that its formally accepted nomenclature be maintained, unless you have a valid reason for revising the name or its stratigraphic or lithodemic unit designation (for more information, see discussion in the section below entitled "Naming, Revising, and Abandoning Formal Geologic Units"; see also, Stamm, 2023 [this volume]).

If you are naming a newly mapped informal unit, the name of the informal unit should consist of the lithology of the unit (in lowercase), followed by the name of the place where it was examined. For example, an informal unit could be named "the rhyolite of Devils Gate" or "the rhyolite at Devils Gate" but not "the Devils Gate rhyolite." However, do not use a place name that already has a formal or informal unit named for it.

If you are mapping an informally named unit that has already been named by a previous mapper, the reference to that mapper's work needs to be added—as in this "fictitious" example of an informally named unit, "the Acme sandstone of Doe (1966)"—the first time the name appears in each stand-alone part of a report.[1] Thereafter, and succeeding usage of the name in a stand-alone part of a report can be written as "the Acme sandstone."

[1]Stand-alone parts of a report are the abstract or executive summary, the main body of the report, the summary or conclusions, the acknowledgments, the Description of Map Units, and each figure, table, and appendix.

## Undivided Versus Undifferentiated Units

The terms "undivided" and "undifferentiated" have different meanings when used in map-unit descriptions to denote the combining of geologic units or lithologies.

The term "undifferentiated" should be used when combining rock types or when a map unit is not separated into different lithological elements, as in the following examples:

- Surficial deposits, undifferentiated
- Undifferentiated lava flows
- Gabbro and diorite, undifferentiated
- Silurian sedimentary rocks, undifferentiated

The term "undivided" should be used when map units have been combined or when a parent unit is being mapped in addition to its formal or informal subunits, as in the following examples:

- Lincolnshire and New Market Limestones, undivided
- Helderberg Group, undivided
- Painted Hill Formation, undivided (in this case, both the parent unit [the Painted Hill Formation] and its basalt and conglomerate subunits are mapped; see example shown in figure 2)

Conversely, a formation is not "undivided" if it is only mapped as its subunits (formal or informal). Figure 2 shows a few examples of "undivided" units and several that are not.

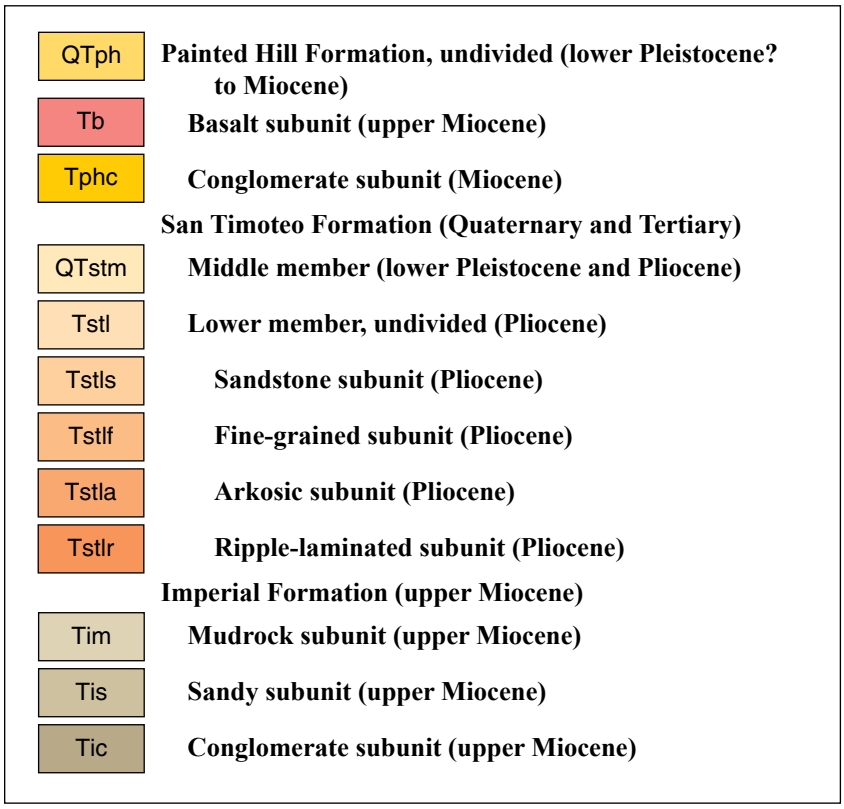


**Figure 2.** Part of a List of Map Units, showing two examples of "undivided" units and several that are not undivided. In the Painted Hill Formation, parent unit QTph is undivided because it is mapped separately, in addition to its two subunits (Tb and Tphc). In contrast, the San Timoteo Formation parent unit is not undivided because it is not mapped separately; it is mapped only as its middle and lower members (QTstm and Tstl, respectively). In addition, the lower member is undivided because it is both mapped separately (Tstl) and as its four subunits (Tstls, Tstlf, Tstla, and Tstlr). The Imperial Formation is not undivided because it is only mapped as its three subunits (Tim, Tis, and Tic).

### Using Question Marks to Express Uncertainty

The query (question mark) can be used to indicate that either the identification or the age of a geologic unit is uncertain. In the written parts of a report (that is, in the discussion, in unit descriptions in the DMU, in figure captions and explanations, and within tables), the query is placed (in parentheses) immediately following the part of the interpretation that is uncertain. For example, the query in "the Morrison(?) Formation" indicates that the rocks may or may not be part of the Morrison Formation. The query after an age designation, such as "the Miocene(?) Imperial Formation" indicates that the rocks may or may not be Miocene age.

The only exception to this convention is when a unit name and age are listed in bold in an LMU or at the beginning of a unit description in the DMU. In these cases, unit ages are shown in parentheses, and so the parentheses are omitted around the query to avoid doubling up of parentheses, as the following example shows (see also, fig. 2):

QTph **Painted Hill Formation, undivided (lower Pleistocene? to Miocene)**

In the graphic parts of a report (that is, on the map or in a figure), a query can be added to a map-unit label to indicate that the identification of a geologic unit is uncertain. The query should be placed at the end of the unit label, without parentheses (for example, "Qls?").

Note that a query is never added to a unit label in the CMU, DMU, or LMU, even if the unit is queried on the map. Note also that uncertainty in the location of a unit should not be expressed by using a queried map-unit label but rather by the style (dashed or dotted) of the line symbol (contact or fault) that bounds it.

# Other Considerations When Preparing a Geologic Map or Report or Conducting a Geologic Names Review

## Informal Time and Age Terms and Suggested Alternative Terms for Position, Place, Quantity, or State

A common mistake made by authors is to incorrectly use time (or age) terms when describing the position, place, quantity, or state of a geologic unit, entity, or observation. Table 4 compares some commonly used informal time or age terms with some suggested alternatives that should be used instead to indicate position, place, quantity, or state of being.

## Time Duration Versus Points in Time

Different abbreviations are used to designate either a point in time (age) or a duration or span of time. Points in time (ages) are referenced to the present, whereas a duration of time lacks a specific reference to the present (for example, yr is the abbreviation for a single year; k.y., for a thousand years; m.y., for a million years; and b.y., for a billion years). Points in time (ages) are specified in International System of Units (SI units) abbreviations (ka, for kilo-annum, or thousand years ago; Ma, for mega-annum, or million years ago; and Ga, for giga-annum, or billion years ago). Note that, when using points in time, the redundant terms "ago" and "before present" are not used. The exception is radiocarbon ages, which are given in years before present (yr B.P.); the abbreviation "B.P." means before 1950 C.E.

Table 5 compares the abbreviations that should be used when designating either a point in time (age) or a duration or span of time.

**Table 4.** Comparison of informal age and time terms and suggested alternative terms that should be used for position, place, quantity, or state.

[Modified from Owen (2009)]

| Age or time term | Suggested alternative term to be used for position, place, quantity, or state |
|---|---|
| Age term versus position term | |
| late | upper |
| early | lower |
| latest | uppermost |
| earliest | lowermost |
| younger | higher |
| older | lower |
| youngest | highest |
| oldest | lowest |
| post-, after | above |
| pre-, before | below |
| Time term versus term for place, quantity, or state | |
| when | where |
| then | there |
| now | here |
| while | whereas, although |
| sometime(s) | someplace(s), some of |
| always | everywhere, all of |
| never | nowhere, none of |
| at times | in some places |
| infrequent | scattered, sparse, rare |
| often, frequent(ly) | abundant, common(ly) |
| infrequent(ly) | rare(ly) |
| usual(ly) | typical(ly) |
| occasional(ly) | local(ly) |
| during | in, over |
| further | farther |
| occurs | is found, is present, is mapped, is exposed, crops out |

**Table 5.** Standard abbreviations for durations of and points in time.

| Duration of time (interval) | Abbreviation | Point in time (age) | Abbreviation |
|---|---|---|---|
| thousand years | k.y. | kilo-annum (or $10^3$ [thousand] years ago) | ka |
| million years | m.y. | mega-annum (or $10^6$ [million] years ago) | Ma |
| billion years | b.y. | giga-annum (or $10^9$ [billion] years ago) | Ga |

## Order of Map Units and Their Ages in Discussions Versus in CMUs, DMUs, LMUs, and Other Map Elements

In discussions on geologic maps or in reports, the stratigraphy and map units are discussed in order from oldest to youngest (or lowermost to uppermost), by convention. For example, basement rocks are discussed before surficial deposits, followed by discussion of the structure and other topics. To maintain this order in the discussion, unit ages are given from oldest to youngest, as are isotopic ages (see examples below).

In contrast, units that are graphically displayed in stratigraphic sections and correlation charts are shown in stratigraphic or geochronologic order, with the youngest units at the top and the oldest units at the bottom. Similarly, when depicting stratigraphy in a CMU, it is customary to show the youngest units at the top and the oldest at the bottom. Thus, it follows that map units in a DMU or LMU, as well as in illustration explanations and captions and in tables, are listed or described in order from youngest to oldest (or uppermost to lowermost) (fig. 3), by convention. The same principle applies to isotopic ages that are provided in a DMU, table, or illustration explanation or caption. Therefore, when providing ages or positions of map units in a DMU or LMU, they should be in youngest (uppermost) to oldest (lowermost) order.

The following examples illustrate the ways that units are listed and ages are cited when they are mentioned in different parts of a report.

- In the discussion of a report:
  - The geology is discussed in oldest-to-youngest order
  - When a unit is mentioned, its age is given from oldest to youngest—for example, "mapped as the Silurian and Devonian Helderberg Group"
  - When multiple units are mentioned, they are listed in oldest-to-youngest order—for example, "overlies the Cretaceous granitic rocks of Montara Mountain and the upper Miocene and Pliocene Purisima Formation"
  - Isotopic ages are given in oldest-to-youngest order—for example, "Lava flows range in age from 75.3 to 62.1 Ma"
- In the CMU:
  - Units are depicted in stratigraphic order (top to bottom, youngest to oldest)
  - Unit ages are given from youngest to oldest—for example, "Purisima Formation (Pliocene and upper Miocene)"
- In the DMU and LMU:
  - Units are listed in stratigraphic order (top to bottom, youngest to oldest)
  - Unit names and ages are shown in bold
  - Unit ages are given from youngest to oldest—for example, "Purisima Formation (Pliocene and upper Miocene)"
- Within a unit description in the DMU:
  - When a unit is mentioned, its age is given from youngest to oldest—for example, "mapped as the Devonian and Silurian Helderberg Group"
  - When multiple units are mentioned, they are listed in youngest-to-oldest order—for example, "overlies the Pliocene and upper Miocene Purisima Formation and the Cretaceous granitic rocks of Montara Mountain"
  - Isotopic ages are given in youngest-to-oldest order—for example, "Age of lava flows, 62.1 to 75.3 Ma"
- In illustrations:
  - Units are shown in the explanation in stratigraphic order (top to bottom, youngest to oldest)
  - Unit ages are listed in the explanation and in the caption from youngest to oldest
  - When multiple units are mentioned in the caption, they are listed in youngest-to-oldest order
- In tables:
  - Units are listed from youngest to oldest

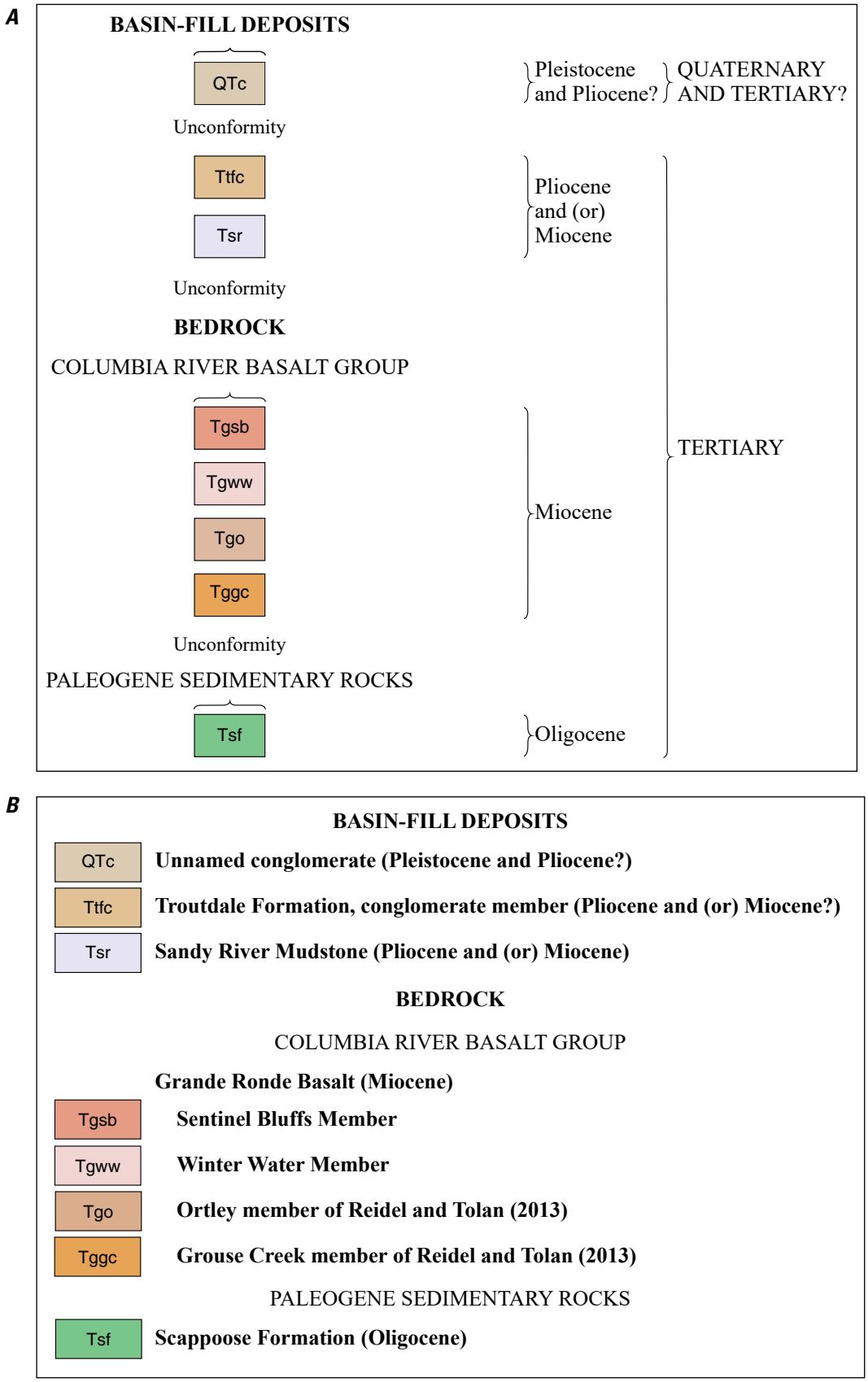


**Figure 3.** Parts of a Correlation of Map Units (CMU) and its corresponding List of Map Units (LMU), excerpted from Evarts and others (2016). *A*, CMU depicting map units and ages from youngest (or uppermost) to oldest (or lowermost). *B*, LMU for CMU shown in *A*, showing listing of map units and ages from youngest (or uppermost) to oldest (or lowermost).

- Unit ages are listed from youngest to oldest
- When multiple units are mentioned, they are listed in youngest-to-oldest order

An exception to the conventions outlined above are ages of events such as volcanic eruptions. Events have a beginning and an end, and so it is logical that the age of an event is given from its beginning to its end (that is, from oldest to youngest), regardless of where it is mentioned in a report.

### Misuses—Slang, Abbreviations, and Imprecision

It is important not to use slang or unaccepted abbreviations because doing so may negatively impact the accuracy and precision of the use of geologic or temporal units and terms. High-quality scientific publications require proper and consistent usage, as outlined in this report. The following list contains some common examples of slang or otherwise unacceptable usage:

- Do not say "Cambro-Ordovician"—Say "Cambrian-Ordovician" (for example, "the Cambrian-Ordovician boundary")
- Do not abbreviate "Formation" or other formal rank names in discussions, DMUs, or LMUs—If you must use abbreviations in tables or on figures because of limited space, be sure to define the abbreviations in the table headnote or in the caption
- Do not use geologic unit names to imply time (for example, do not say "the pre-Dakota unconformity" or "Beekmantown time")
- Do not use map-unit labels in place of geologic unit names in DMUs or discussions—If you must use unit labels in a DMU to avoid the excessive repetition of a unit name or because of limited space, be sure to spell out the full unit name the first time it is used in the description
- Never use the same name for a geologic unit's rank and for one of its components (for example, "the Helderberg Formation of the Helderberg Group" cannot exist)
- Do not add a lithologic term to the end of a formation or group name (for example, do not say "the Elbrook Formation limestone"—Say "limestone of the Elbrook Formation")
- Do not say "the lower Choptank Formation," which implies that you have two different formations—Say "the lower part of the Choptank Formation"

## Naming, Revising, and Abandoning Formal Geologic Units

As geoscience progresses, a need often arises to either formalize, revise, abandon, or reestablish geologic names. Geologic mapping is a catalyst of these changes where units need to be mappable. Sedimentary facies can change across different regions, and the thicknesses of units and the nature of contacts may change, owing to unconformities; in such cases, a formal unit may be better represented as a formation in one area but as a member in another. The Code (NACSN, 2021) lays out the procedures for changing stratigraphic nomenclature (see articles 3–20). Additional guidance and discussions on this topic are provided in Stamm (2023 [this volume]).

## How You Can Enhance or Update Geolex

As previously noted, Geolex (https://ngmdb.usgs.gov/Geolex/), which is part of NGMDB, serves the geologic communities with current and historical information on formally named lithostratigraphic units. As Geolex is the standard reference for the Nation's stratigraphic nomenclature, its purpose is to aid authors and reviewers on the definitions and usage of geologic names.

As authors name, revise, or publish new comprehensive stratigraphy, it is important to notify the NGMBD—specifically, the GNC (gnc@usgs.gov)—so it can keep Geolex up to date. Authors can help ensure that Geolex continues to meet its goals (see Stamm, 2023 [this volume]) by following these guidelines:

- If your manuscript has a comprehensive discussion of stratigraphy or extensive use of geologic nomenclature, please forward it to the GNC staff (gnc@usgs.gov)
- If you notice changes from other publications that are not yet included in Geolex, please inform the GNC staff (gnc@usgs.gov) by forwarding the reference citation and a note that explains the discrepancy

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# Chapter D, Appendix 1. Selected Resources for Authors and Reviewers of Geologic Maps and Reports

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