GEOLOGIC NAMES AND USAGE: A GUIDE TO STRATIGRAPHIC NOMENCLATURE

by Randall Orndorff, USGS



AGI Webinar, 24 February 2022



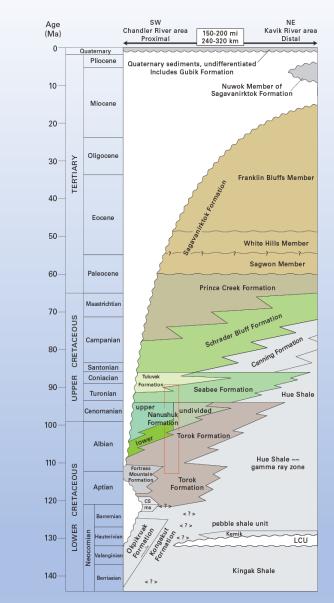
Why Geologic Names Reviews are Important

- Consistent and effective communication to colleagues and the public
- Clear explanations
- Precise discussion of scientific data and interpretation
- Pride in the quality of USGS products

A geologic names review is more than spell checking; also includes:

- 1. Conformance with North American Stratigraphic Code
- 2. Conformance with stratigraphic principles
- 3. Consistency between text, correlation charts, description of map units, figures, tables, etc.

Geologic names reviews started in the USGS in 1899, and was consistent until 1995



From Mull and others (2006)



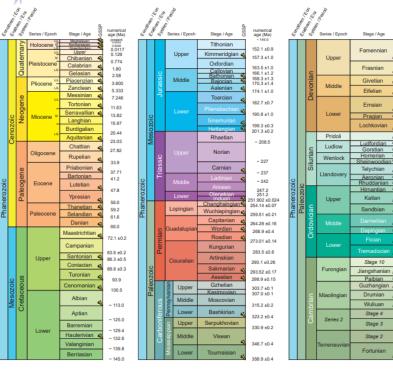
International Subcommission on **Stratigraphic Classification of IUGS** International Commission on Stratigraphy

INTERNATIONAL STRATIGRAPHIC GUIDE



IUGS

INTERNATIONAL CHRONOSTRATIGRAPHIC CHART v 2021/10 www.stratigraphy.org International Commission on Stratigraphy



How to use stratigraphic terminology in papers, illustrations, and talks

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ABSTRACT: Some writers, speakers, and students have problems with clear usage of stratigraphic terminology, a topic made more sorte by the appearance of the complex 1983 North American Stratigraphic Code, in 2005 revision, and new editarios of the International Stratigraphic Guide. The basic categories of stratigraphic units are: 1) material: 2, non-material: 3), bybrid: Examples are the well-known next (Hithoutaniz graphic), time (goochronologic), and time-next (chronostratigraphic) units, respectively, Biostratigraphic units (biosons) are used to describe and corollate time next (suits Lauer-Annown exigencies include magnetostratigraphic), Biodernics, pedostratigraphic, diachronic, and unconformity-related units. Sequence-stratigraphic nomenclature, still developing, is in a state of tur moil at present

Both formal and informal stratigraphic units are recognized. All words in formal units are capitalized, except for species names in biozones. Only the geographically derived name in informal units is generally capitalized. Inadequate distinction between time and place words, both formal and informal, leads to unnecessary confusion. Misuse of early versus lower, late versus upper, and Ma for Myr

Web sites and publications such as lexicons, geologic time scales, and correlation charts are recommended as initial sources of stratigraphic information. Naming, revising, and abandoning formal stratigraphic names are governed by specific rules for names to be ac-cepted. In illustrations of stratigraphic units, it is important to distinguish clearly between scales of time and position. Strata are not

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~ 720

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3600

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Ediacaran r

Cryogeniar

Tonian

Stenian

Ectasian

Calymmia

Statheria

Orosirian

Rhyacian

Sideriar

tatatatatatatatatatatatatatatata

Units of all ranks are in the process of being defined by Global Boundary

Numerical ages are subject to revision and do not define units in the

Phanerozoic and the Ediacaran; only GSSPs do. For boundaries in the Phanerozoic without ratified GSSPs or without constrained numerical

Ratified Subseries/Subspochs are abbreviated as U/L (Upper/Late), M

(Middle) and L/E (Lower/Early). Numerical ages for all systems except Quaternary, upper Paleogene, Cretaceous, Triassic, Permian and Precambrian are taken from 'A Geologic Time Scale 2012' by Gradstein et al. (2012), those for the Quaternary, upper Paleogene, Cretaceous,

hart drafted by K.M. Cohen, D.A.T. Harper, P.L. Gibbard, N. Car

To cite: Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; updated) The ICS International Chronostrativeship (Press Formation)

URL: http://www.stratigraphy.org/ICSchart/ChronostratChart2021-10.pd

mitrian were provided by the relevant ICS

CCGN CGMV

placeholders for unnamed units. Versioned charts and detailed inf on ratified GSSPs are available at the website http://www.stratigra The URL to this chart is found below.

ages, an approximate numerical age (~) is provided.

Bratotype Section and Points (GSSP) for their lower boundaries, including those of the Archean and Proterozoic, long defined by Global Standard Stratigraphic Ages (GSSA). Italic fonts indicate informal units and

Neo

Neo

Meso-archear

Paleo-archear

Hadean

Vell-kno

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INTRODUCTION

numerical age (Ma) 358.9 ±0.4

372.2 ±1.6

382.7 ±1.6

387.7 ±0.8

393.3 ±1.2

407.6 +2.6

410.8 ±2.8

419.2 ±3.2

423 0 +2 3

425.6±0.9

427.4 ±0.5

 430.5 ± 0.7

433.4 ±0.8

438.5 ±1.1

440.8 ±1.2

443 8 +1 5

445.2 ±1.4

453.0 ±0.7

458.4.+0.9

467.3 ±1.1

470.0 ±1.4

477.7 ±1.4

485.4 +1.9

- 489.5

~ 494 ~ 497

- 500.5

- 504.5

~ 509

~ 514

~ 521

~ 529

541.0 +1.0

Stage 4

Since publication of the latest revision of the North American Stratigraphic Code [North American Commission on Strati-graphic Nomenclature (NACSN 2005)], I have been asked to revise and update my previously published papers on using stratigraphic nomenclature (Owen 1978, 1987) which have proved useful to writers, speakers, and students who strive for lear usage of stratigraphic nomenclature, including forma terms, informal conventions, and in illustrations. The 2005 North American Stratigraphic Code (hereafter referred to as the Code) is much the same as the 1983 North American Stratigraphic Code (NACSN 1983), except for the completely revised aphicunits. Stratigraphic nomenclature was

The purposes of this paper are; 1) to summarize, in plain language, the currently available types of formal stratigraphic units and their usage: emphasizing the most-commonly used units, and 2) to review some informal conventions that are standard proce lure in stratigraphic writing and editing, but which are not writ ten in the Code. Guide, or any other readily available source.

CATEGORIES OF STRATIGRAPHIC UNITS

In stratigraphic work, two fundamental categories of units are recognized: 1) material units, based on actual bodies of rock; 2) non-material units, based on the abstract concept of geologic unit, is also recognized. A chronostratigraphic unit is an actual ody of rock that serves as the referent for the interpreted geoogic time during which that body of rock was deposited

NORTH AMERICAN STRATIGRAPHIC CODE¹

North American Commission on Stratigraphic Nomenclature

FOREWORD TO THE 1983 CODE

The 1983 Code of recommended procedures for

sifying and naming stratigraphic and related units was

pared during a four-year period, by and for North Ame

earth scientists, under the auspices of the North Ame

Commission on Stratigraphic Nomenclature. It repres

the thought and work of scores of persons, and thousan

hours of writing and editing. Opportunities to participa

velopment, as cited in the Preamble, to a degree unp

and review the work have been provided throughout

dented during preparation of earlier codes.

FOREWORD TO THE REVISED EDITION

By design, the North American Stratigraphic Code is meant to be an evolving document, one that requires change as the field of earth science evolves. The revisions to the Code that are included in this 2005 edition encompass : broad spectrum of changes, ranging from a complete revision of the section on Biostratigraphic Units (Articles 48 to 54), several wording changes to Article 58 and its remarks concerning Allostratigraphic Units, updating of Article 4 to in orporate changes in publishing methods over the last two decades, and a variety of minor wording changes to improve clarity and self-consistency between different sections of the Code. In addition, Figures 1, 4, 5, and 6, as well as Tables 1 and Tables 2 have been modified. Most of the change adopted in this revision arose from Notes 60, 63, and 64 of the Commission all of which were published in the AAPG Bulletin. These changes follow Code amendment procedure as outlined in Article 21. We hope these changes make the Code a more usable ocument to professionals and students alike. Suggestions for future modifications or additions to the North American Stratigraphic Code are always welcome. Suggested and adopted modifications will be announced to the profession

AAPG Bulletin, Suggestions may be made to representatives of your association or agency who are current commis-sioners, or directly to the Commission itself. The Commis-

sion meets annually, during the national meetings of the Geological Society of America. 2004 North American Commission on Stratigraphic Nomenclature

¹Manuscript received November 12, 2004: provisional acceptance February 10 2005; revised manuscript received May 19, 2005; final acceptance July 05, 2005. DOI:10.1306/07050504129

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1547
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Divisions of Geologic Time— Major Chronostratigraphic and Geochronologic Units

Introduction .- Effective communication in the geosciences requires a consistent nomenclature for stratigraphic units and. especially, for divisions of geologic time. A geologic time ----1 is composed of standard stratigraphic divisions based on p

sequences and is calibrated in years (Harland and others, 1 Geologists from the U.S. Geological Survey (USGS). geological surveys, academia, and other organizations requ consistent time scale to be used in communicating ages of logic units in the United States. Many international debate occurred over names and boundaries of units, and various scales have been used by the geoscience community

Updated time scale .- For consistent usage of time ter the USGS Geologic Names Committee (GNC; see box for bers) and the Association of American State Geologists de oped the Divisions of Geologic Time; the 2018 update she in figure 1 contains the unit names and boundary age estin ratified by the International Commission on Stratigraphy (Scientists may use other published time scales, provided th these are specified and referenced (for example, Palmer, 1 Harland and others, 1990; Haq and Eysinga, 1998; Gradst others, 2012; Walker and others, 2012; Ogg and others, 20

Advances in stratigraphy and geochronology require t time scale be periodically updated. Therefore, the Division Geologic Time is dynamic and is modified as needed to inc accepted changes of unit names and boundary age estimate fact sheet updates the Divisions of Geologic Time released two previous USGS fact sheets (U.S. Geological Survey G Names Committee, 2007, 2010).

The Divisions of Geologic Time (fig. 1) shows the m chronostratigraphic (position) and geochronologic (time) t that is, from largest to smaller, enonothem/eon to series/en divisions. The National Geologic Map Database (https://ng usgs.gov/Geolex/stratres/timescales) has additional resource and information (such as stage/age terms). The systems of Mesozoic are subdivided into formal series designated by terms "Lower," "Middle," and "Upper." The correspondin periods are subdivided into formal epochs designated as "I "Middle," and "Late." Similarly, the Ordovician and Devo Systems and the Mississippian and Pennsylvanian Subsyst of the Paleozoic are subdivided into formal series designat as "Lower," "Middle," and "Upper"; the formal epochs are designated as "Early," "Middle," and "Late." The Silurian Permian are divided into series/epochs that have individua names. Because some of the series/epoch names for the Ca brian have been set and some have not, the placeholders " Early," "Middle," and "Upper/Late" may be used. All othe of "lower/early," "middle," and "upper/late" are acceptable as informal units (lowercase). The GNC will not include n series/epoch names in the Divisions of Geologic Time unt are named for a specific system/period.

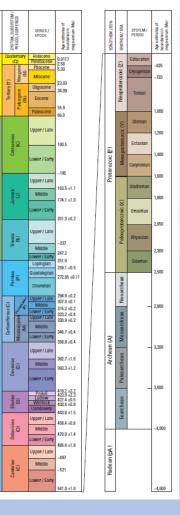
U.S. Department of the Interior U.S. Geological Survey

Publication of the International Stratigraphic Guid 1976 made evident some insufficiencies of the American Stratigraphic Codes of 1961 and 1970. The Commission considered whether to discard our codes, patch them over, or rewrite them fully, and chose the last. We believe it desirable to sponsor a code of stratigraphic practice for use in North America, for we can adapt to new methods and points of view more apidly than a worldwile body. A timely ex-ample was the recognized need to develop modes of establishing formal nonstratiform (igneous and high-grade meta-morphic) rock units, an objective that is met in this Code, but not yet in the Guide. The ways in which the 1983 Code (revised 2005) differs

from earlier American codes are evident from the Contents. Some categories have disappeared and others are new, but this Code has evolved from earlier codes and from the International Stratigraphic Guide. Some new units have not yet stood the test of long practice, and conceivably may not, but they are introduced toward meeting recognized and defined needs of the profession. Take this Code, use it, but do not condemn it because it contains something new or not of direct interest to you. Innovations that prove unaccept-able to the profession will expire without damage to other concepts and procedures, just as did the geologic-dimate units of the 1961 Code.

The 1983 Code was necessarily somewhat innovative because of (1) the decision to write a new code, rather than to revise the 1970 Code; (2) the open invitation to members of the geologic profession to offer suggestions and ideas both in writing and orally; and (3) the progress in the earth sciences since completion of previous codes. This report

Cenozoic .--- A controversial issue during the first decade of the 21st century was the position of the base of the Quaternary





AAPG BULLETIN, V. 89, NO. 11 (NOVEMBER 2005), PP. 1547-1591

as in the past, by serial Notes and Reports published in the

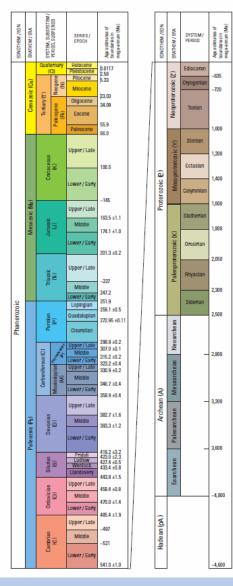
"Authors must strive for clarity, consistency, and correct usage of both formal and informal terminology because of the complex interactions between time and space interpreted from the presently existing stratigraphic record"

Don E. Owens, 2009, How to use stratigraphic terminology in papers, illustrations, and talks: Journal of Stratigraphy, v. 6, n. 2, p. 106-116.

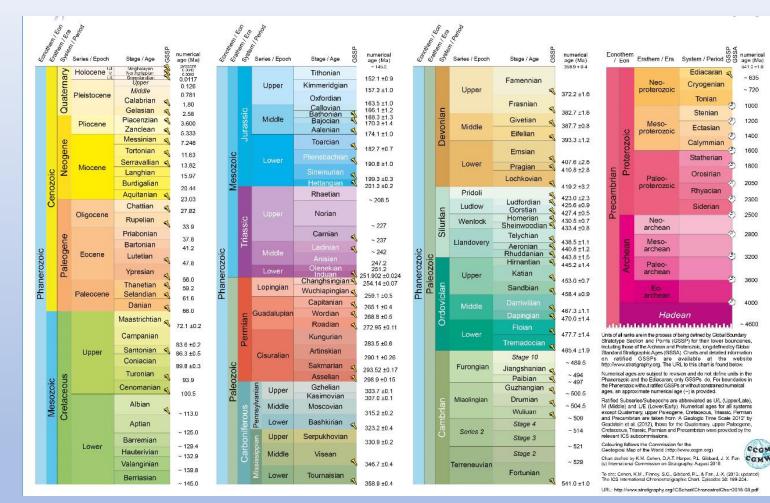




USGS Time Scale - FS 2018-3054 (static; update coming in 2022)



International Commission on Stratigraphy Time Chart (dynamic)



http://www.stratigraphy.org/index.php/ics-chart-timescale



numerical

~ 635

~ 720

1000

1200

1400

1600

1800

2050

2300

2500

2800

3200

3600

4000

~ 4600

CCGM

age (Ma)

https://doi.org/10.3133/fs20183054

Examples of Rank Hierarchy Terms of the Geologic Time Scale

POSITION (CHRONOSTRATIGRAPHIC)	TIME (GEOCHRONOLOGIC)	
Phanerozoic Eonothem	Phanerozoic Eon	
Cenozoic Erathem	Cenozoic Era	
Quaternary System	Quaternary Period	
Pleistocene Series	Pleistocene Epoch	
Gelasian Stage	Gelasian Age	

A *chronostratigraphic unit* is a body of rock established to serve as the material reference for all rocks formed during the same span of time. A *geochronologic units* is a division of time distinguished on the basis of the rock record preserved in a chronostratigraphic unit.

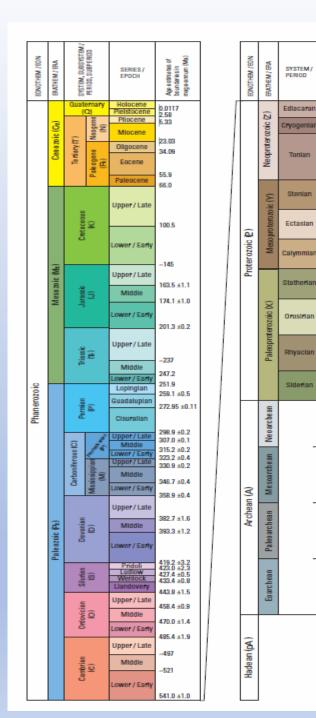


Upper, Middle, Lower versus Late, Middle, Early (chronostratigraphic (position) versus geochronologic (age))

"Fragile items are placed on upper shelves, not late shelves."

"Ski season is in the early part of the year, not the lower part of the year."





Age estimates bounderies in mega-amum ()

720

1,000

1,200

1,400

1,600

1,900

2,050

2,300

2,500

2,900

3,200

3,600

4,000

4,600

Examples of position vs. age (fill in the blank)

Here, _____ Tertiary sediments unconformably overlie Paleozoic rocks. [*lower or early*?]

Here, lower Tertiary sediments unconformably overlie Paleozoic rocks.

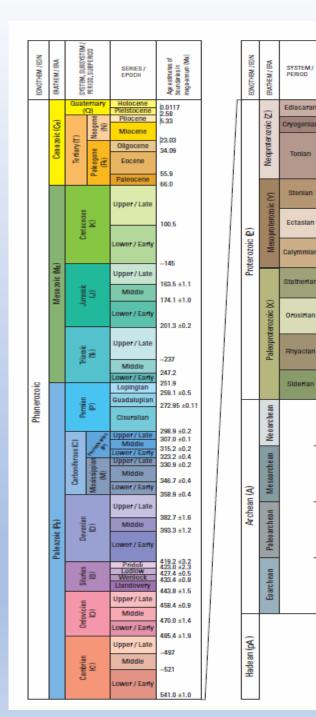
The volcanic eruption occurred before the _____ Oligocene. [*upper or late*?]

The volcanic eruption occurred before the late Oligocene.

This unit is correlative with the _____ Oligocene Vicksburg Group. [*lower or early?*]

This unit is correlative with the lower Oligocene Vicksburg Group.





Age estimat bounderies i

720

1.000

,200

.400

.600

1,900

2,050

2,300

2,500

2,900

3,200

3,600

4,000

4,600

Examples of position vs. age (fill in the blank), continued

Granitic rocks intruded the Menominee Group in the _____ Mesoproterozoic. [*upper or late*?]

Granitic rocks intruded the Menominee Group in the late Mesoproterozoic.

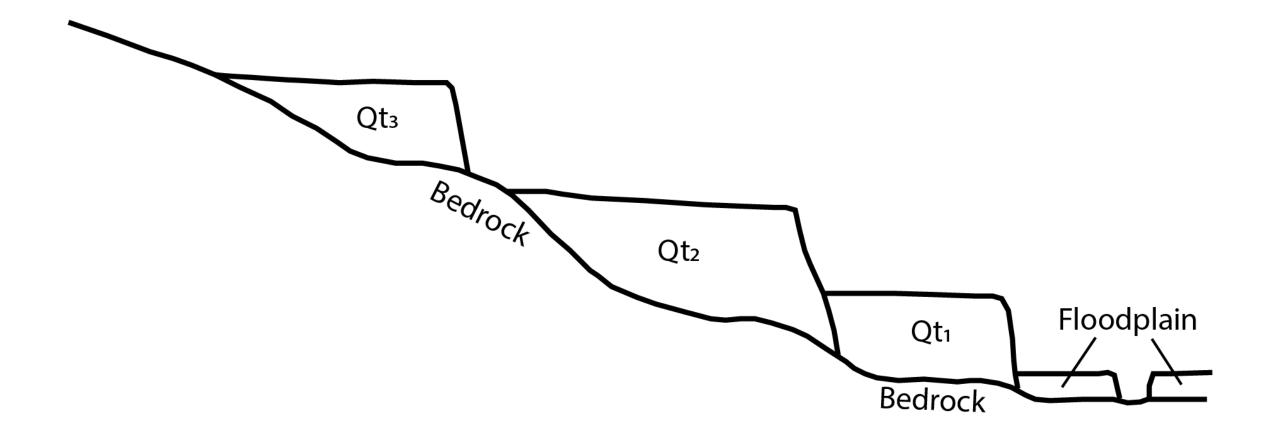
The Middle-____ Pennsylvanian boundary is placed at the top of the informal Mason coal bed. [*Upper or Late?*]

The Middle-Upper Pennsylvanian boundary is placed at the top of the informal Mason coal bed.

The _____ Pleistocene terrace deposit lies 100 feet above the _____ Pleistocene deposit. [*lower or early/upper or late?*]

The early Pleistocene terrace deposit lies 100 feet above the late Pleistocene deposit.







Stay Away from Slang, Abbreviations, Impreciseness

Use Cambrian-Ordovician, NOT Cambro-Ordovician

Spell out "Formation", etc. on tables and figures; if you must use abbreviations on tables or figures, define in caption

Do **NOT** use unit names to imply time; examples – *pre-Dakota unconformity, Beekmantown time*

NEVER use the same name for a rank and one of its components; example – *Helderberg Formation of the Helderberg Group*

Be precise - Do **NOT** add lithology to end of the formation or group name; example – *Elbrook Formation limestone* should be *limestone of the Elbrook Formation*

Be precise – Use *lower part of the Choptank Formation*, NOT *lower Choptank Formation* (implies two different formations)

*Remember, authors who are careless run the risk of the perception of carelessness extending to data collection, analysis, interpretations, and conclusions.



Uppercase or Lowercase?

Series/epochs are uppercase:

All series/epochs used to be formal Lower/Early, Middle, Upper/Late

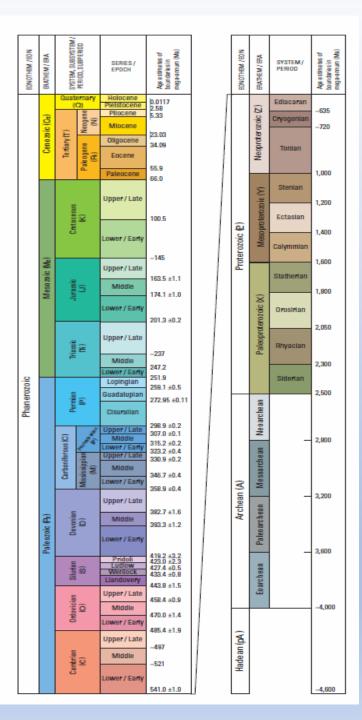
Today, some series/epochs of the geologic time scale are named:

The Silurian, Permian, Tertiary, and Quaternary Systems/Periods are completely subdivided into named series/epochs.

The rest use Lower/Early, Middle, and Upper/Late as "placeholders," and so they are capitalized. For example, Upper Cretaceous, Middle Jurassic, and Lower Devonian Series (Late Cretaceous, Middle Jurassic, and Early Devonian Epochs).

Informal subdivisions of chronostratigraphic/geochronologic units are lowercase:

upper Paleozoic – shorthand for upper part of the Paleozoic Erathem late Paleozoic – shorthand for late part of the Paleozoic Era



Uppercase or Lowercase?

_ Miocene [*upper or Upper?*]

upper Miocene

___ Cretaceous [*late or Late?*]

Late Cretaceous

_____ Silurian [*lower or Lower?*]

lower Silurian; formally Llandovery

_____ Permian [*middle or Middle?*] middle Permian; formally Guadalupian

____ Cretaceous [middle or Middle?]

middle part of the Cretaceous

__ Mesozoic [lower or Lower?]

lower Mesozoic

_____ Ordovician [*upper or Upper?*]

Upper Ordovician

_____ Tertiary [*lower or Lower?*]

lower Tertiary; formally Paleocene to Oligocene/Paleogene



Geologic Units Spanning Chronostratigraphic/Geochronologic Units (use of "to," "and," "or")

A geologic unit can be assigned to more than one chronostratigraphic or geochronologic unit:

The term "*to*" means relatively continuous deposition or time; for example, Ordovician *to* Devonian includes the Silurian.

The term "*and*" means a significant amount of missing strata or time; for example, Ordovician *and* Devonian excludes the Silurian.

As a single horizon cannot span time, use "*or*"; for example, Ordovician or Silurian.





Numerical Ages

Duration of Time	Abbreviation	Points in Time	Abbreviation
thousand years interval	k.y.	kilo-annum (10 ³ years ago)	ka
million years interval	m.y.	mega-annum (10 ⁶ years ago)	Ma
billion years interval	b.y.	giga-annum (10 ⁹ years ago)	Ga

Duration of time is **without** specific reference to the present (yr, k.y., m.y., b.y.).

Points in time are before present and uses standard international (SI) unit abbreviations (ka, Ma, Ga). Do **NOT** use redundant terms "ago" or "before present"!



Numerical Ages (examples)

Continuous eruption occurred for almost 2 _____. [*k.y. or ka?*] Continuous eruption occurred for almost 2 k.y.

Potassium-argon (K-Ar) dating of the gneiss yielded a crystallization age of 550 ____. [*m.y. or Ma*?]

Potassium-argon (K-Ar) dating of the gneiss yielded a crystallization age of 550 Ma.

Resulting ²³⁰Th/U ages that constrain deposition range from 397 ± 27 _____ to 248 ± 9 _____. [*k.y. or ka?*]

Resulting 230 Th/U ages that constrain deposition range from 397 ± 27 ka to 248 ± 9 ka.



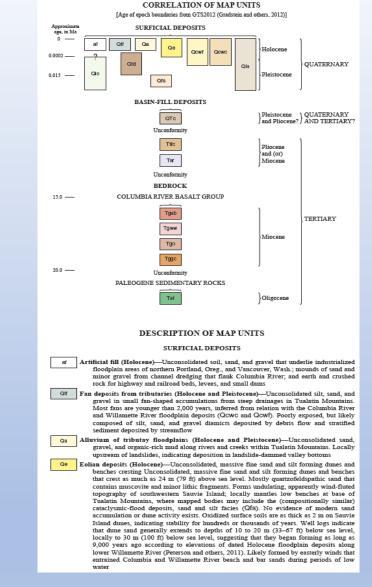
Order of Discussion of Stratigraphy Older to Younger/Lower to Upper...unless...

In text – describe stratigraphy from older to younger or lower to upper* * sometimes it is feasible to discuss well logs from top to bottom

Example – The Silurian and Devonian Helderberg Group is.....

In graphics (illustrations, tables, charts, correlation of map units, and description of map units) – show stratigraphically or geochronologically, oldest or lowest at bottom/youngest or uppermost at top

Example of DMU – DSh Helderberg Group (Devonian and Silurian)



From Evarts and others (2016)



Hierarchy of Rank Terms

Stratigraphic units

Supergroup Group Formation Member *Submember* Bed(s), Flow, Tongue Lithodemic units Supersuite Suite Complex Granite, Gneiss, Schist, Volcanic





Formal versus Informal Geologic Names

- Consult the USGS lexicon of geologic names, Geolex, to determine validity, it's current age designation and where used.
- If using an informal name used by previous workers, add the reference to the name the first time it is used.

Example – Walker sandstone of Haynes (1994)

- Or state, the informal Walker sandstone
- If using your own informal name, state the lithology followed by the place where it was examined the first time it is used. Do not use a place name that already has a formal unit named for it.

Example – rhyolite of Devils Gate, or rhyolite at Devils Gate



Even chronostratigraphic/geochronologic units can be informal Examples – Anthropocene series/epoch; upper Silurian



Undivided vs. Undifferentiated

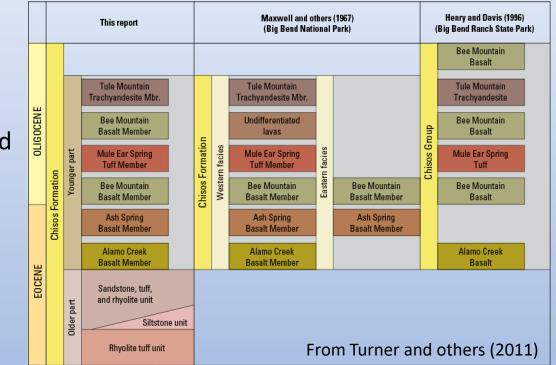
The terms undivided and undifferentiated are mostly used on geologic map descriptions to denote combining of geologic units or lithologies.

Undivided used when combining geologic units; examples -

Lincolnshire and New Market Limestones, undivided Helderberg Group, undivided

Undifferentiated used for combining rock types; examples -

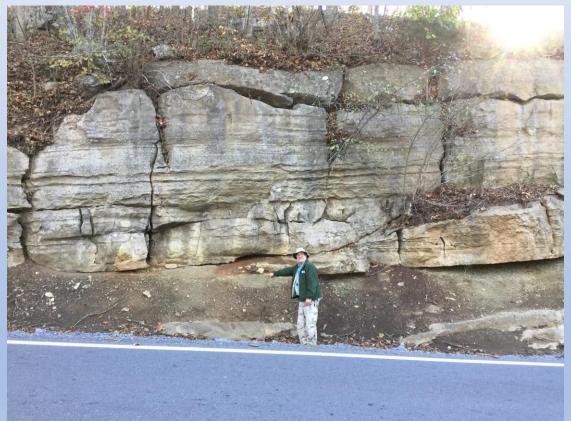
Gabbro and diorite, undifferentiated Silurian sedimentary rocks, undifferentiated Undifferentiated lavas





Changing Nomenclature – New Names

- Consult North American Startigraphic Code (Articles 3-16)
- Choose a name not already in use, consult lexicons
- Reserve name through the NGMDB
- Publish
 - 1. Intent to formally name
 - 2. Rank
 - 3. Derivation of name
 - 4. Type locality/stratotype (if applicable)
 - 5. Lithologic description
 - 6. Definition of boundaries
 - 7. Historical background
 - 8. Dimensions
 - 9. Geographic distribution
 - 10. Correlation
 - 11. Genesis





Changing Nomenclature (cont.) – Revising Names

- Consult North American Stratigraphic Code (Articles 17-19)
- Types of changes to be published as revisions
 - 1. Boundary changes
 - 2. Change in rank
 - 3. Change from one area to another
 - 4. Addition of principal reference section (type sections/localities must not be changed)
 - 5. Age changes



* Redefinition is changing content of unit without changing boundaries or rank and redescription is correcting inadequate or inaccurate description.



Changing Nomenclature (cont.) – Abandoning Names

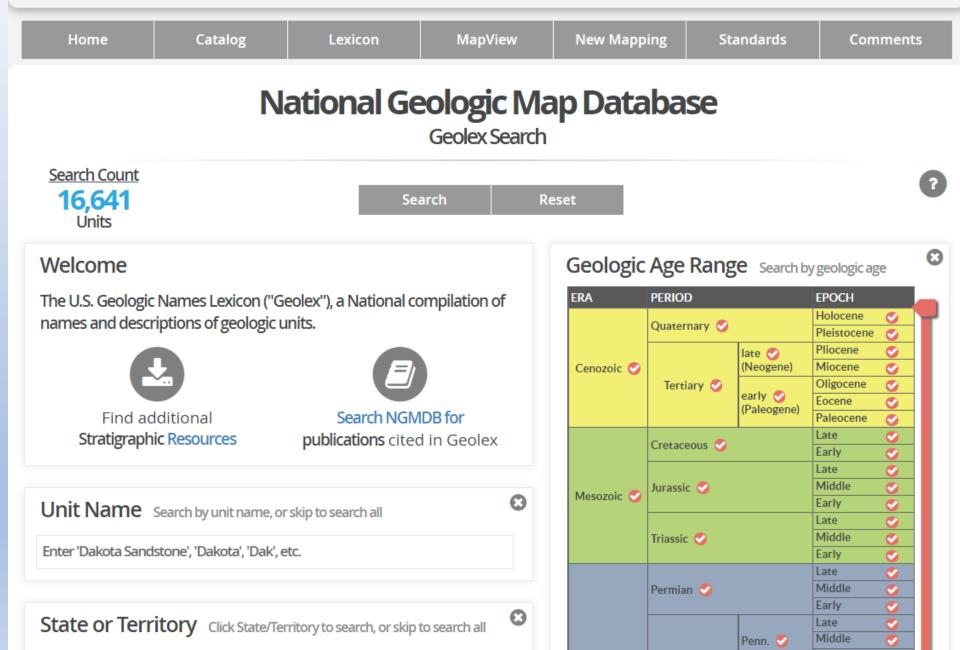
- Consult North American Stratigraphic Code (Article 20) *
- Determine if unit is improperly defined or obsolete
- Do NOT abandon units when intending to restrict its usage in a study area
- Need to have sufficient justification to demonstrate concern for nomenclatural stability:
 - Synonymy or homonymy
 - Improper definition (e.g., defining lithostratigraphic units by chronostratigraphic criteria)
 - Long-term disuse or obsolescence
 - Flagrant misuse or Code violation
 - Impracticability
- Need recommendation for nomenclature to be used in its place





* Abandoned names may be reinstated (see Article 20(e))







What You can do for Geolex

- Geolex is the standard reference for the Nation's stratigraphic nomenclature
- Its purpose is to aid authors and reviewers on usage and definitions of geologic names
- If you notice changes from other publications not yet included, inform NGMDB staff by forwarding reference to <u>gnc@usgs.gov</u>
- If your manuscript has a comprehensive discussion of stratigraphy or nomenclature, forward to NGMDB staff







Resurrected Stratigraphic Notes - 2021 Volume 1 Preliminary Contents



Randall C. Orndorff, Nancy R. Stamm, David R. Soller

Divisions of Geologic Time—Major Chronostratigraphic and Geochronologic Units

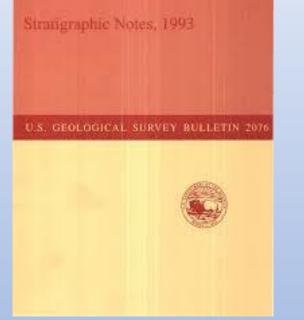
Randall C. Orndorff, Nancy R. Stamm, David R. Soller, Lucy E. Edwards, Julie A. Herrick, Leslie F. Ruppert, Janet L. Slate, Berry H. Tew, Jr.

Reference Notes on Geologic Names Usage for Authors and Peer Reviewers – A Primer on Stratigraphic Nomenclature

Randall C. Orndorff

Template for Papers Submitted to Stratigraphic Notes Nancy R. Stamm





Resources for Authors and Reviewers

- Divisions of Geologic Time Major Chronostratigraphic and Geochronologic Units (USGS FS 2018-3054): <u>https://doi.org/10.3133/fs20183054</u>
- International Chronostratigraphic Chart: <u>http://www.stratigraphy.org/index.php/ics-chart-timescale</u>
- North American Stratigraphic Code: <u>https://ngmdb.usgs.gov/Geolex/resources/docs/NACSN_Code_2021.pdf</u>
- National Geologic Map Database Geolex: <u>https://ngmdb.usgs.gov/Geolex/search</u>
- Journal of Stratigraphy, v. 6, n. 2: <u>http://www.micropress.org/microaccess/stratigraphy/issue-260/article-1638</u> Particularly, *How to use stratigraphic nomenclature in papers, illustrations, and talks*
- USGS Suggestions to Authors 7: https://www.nwrc.usgs.gov/lib/lib_sta.htm
- USGS Suggestions to Authors 8 (Geologic Nomenclature, only): <u>https://ngmdb.usgs.gov/Info/docs/USGS-STA8_GeolNomenChapterDRAFT.pdf</u>



"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"

Don E. Owens, 2009, How to use stratigraphic terminology in papers, illustrations, and talks: Journal of Stratigraphy, v. 6, n. 2, p. 106-116.



