



INTEGRATED STRATIGRAPHY

Amalia Spina

Amalia Spina, PhD.

Office: Palazzina di Geologia,
Second floor

Tel. 0755852696

E-mail: amalia.spina@unipg.it

- Principles of stratigraphy
- The time in stratigraphy; geological chronology (relative and absolute) the temporal sequence of events; standard global chronostratigraphical scale. Comparison between the stratigraphic scales in marine and continental successions.
- Stratigraphic units standard (definition and principle): law of superimposition, principle of original horizontality, of lateral continuity and of biotic succession, the Stratigraphic Code.
- The sedimentary cyclicity
- Lithostratigraphy
- Magnetostratigraphy
- Biostratigraphy
- Chemostratigraphy
- Chronostratigraphy and geochronology
- Astronomic cyclostratigraphy
- Sequence stratigraphy
- Palaeogeographic reconstructions.

Prerequisites:

In order to better comprehend the main topics of integrated stratigraphy, the students that follow this course must have:

- knowledge of the fundamentals of geology;
- knowledge of the sedimentary rocks (classification);
- knowledge of the principle of stratigraphy;
- knowledge of the principle of palaeontology;
- knowledge of the principle of sedimentology;

These preconditions are important for attending and not attending students.

Written test: it consist of the solution of multiple choice test and graphic /practical exercises. The number of questions ranges between 15 and 30 on the basis of the difficulty.The test has a duration of no more than 80 minutes. The goal of the test is to verify the knowledge acquired on the course contents in order to ensure that the student learned the principles of integrated stratigraphy and its main applications. To complete the evaluation the test also consists on the discussion of a case study proposed by the Professor carried out individually or in small groups (max three students).It consists to discuss the stratigraphic features of a certain geological area and the implications for the subsurface hydrocarbon exploitation. The discussion can take advantage of 10 slides and require theoretical insights and clarification of details by the other students and by the board of examiners.

The main purpose of this oral test is to assess the cognitive abilities and understanding of the student's ability to apply the acquired skills, aptitude oral exposure and synthesis.

Some assesments during the period of the course could be scheduled.

To integrate the knowledge, the following optional courses are suggested:

- Micropaleontology
- Sedimentary Petrography

Principles of stratigraphy

What do you see?



Sedimentology vs. Stratigraphy



Sedimentology involves all factors that go into the accumulation of sediment at a specific locality under a relatively uniform set of conditions.



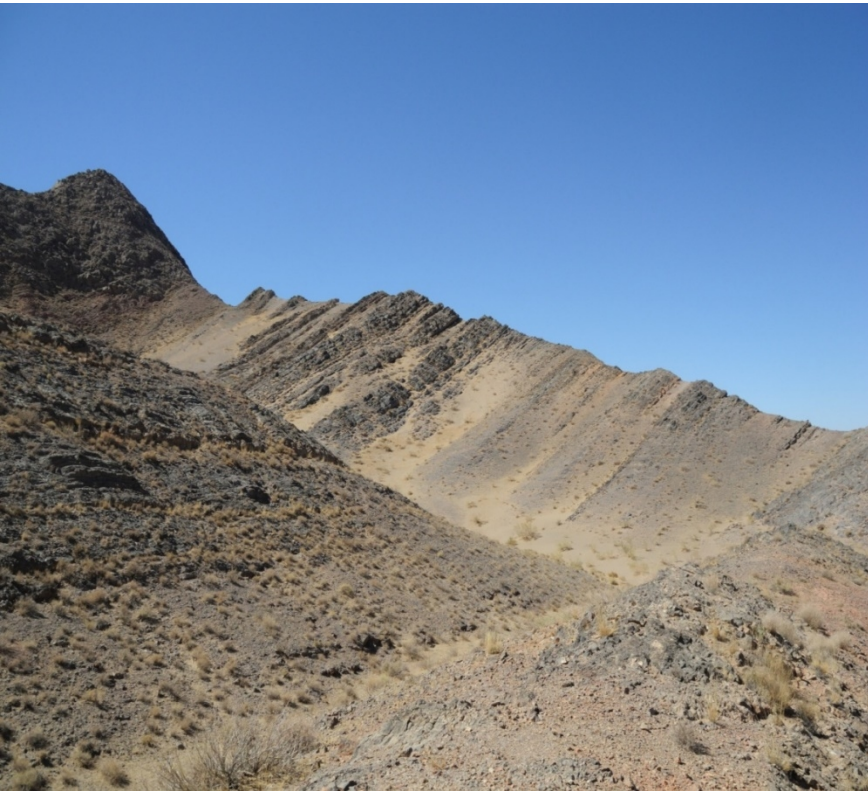
Stratigraphy records changes in sedimentology through time as a vertical succession.

“Stratigraphy can be defined as the complete triumph of terminology over facts and common sense.”

Attributed to P.D. Krynine by J. Ferm *in* Burton et al., 1987.

**Stratigraphy: the study of the
3-D spatial and temporal
relationships among rocks**

Stratigraphy is the study of temporal relationships in sedimentary rock bodies and reflects changes in the balance between rates at which space is produced and filled. Stratigraphy can be considered the history of past geological events and adds the dimension of time to sedimentology.



STRATIGRAPHY

The study of strata (layers) of rocks with an eye toward interpreting the geologic history of the region

Closely tied to dating methods

Uses a variety of methods - fossils, stable isotopes, palaeomagnetism, sedimentary cycles - to correlate and distinguish layers

Very important for oil exploration and mining

Lithostratigraphy

Each layer is a different rock type.

Chronostratigraphy

Each layer is a different age.

Biostratigraphy

Each layer contains a different fossil assemblage.

Lithostratigraphy

Each layer is a different rock type.

Some definitions:

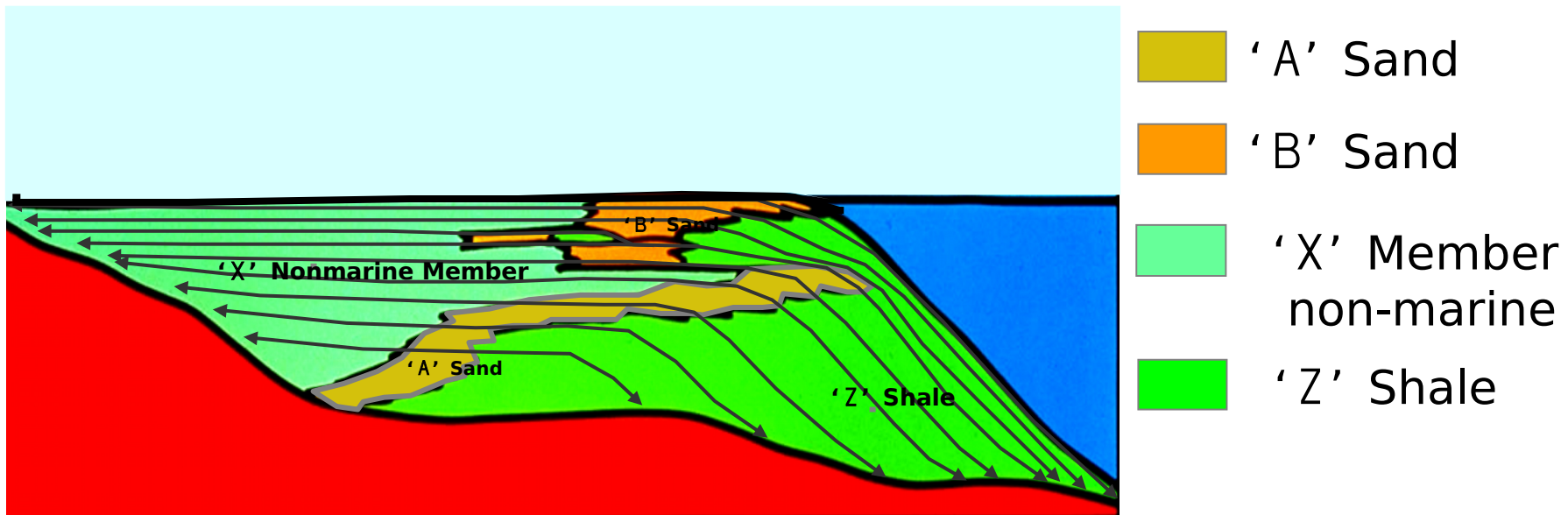
1. Lithostratigraphy. The element of stratigraphy that deals with the description and nomenclature of the rocks of the Earth based on their lithology and their stratigraphic relations.
2. Lithostratigraphic classification. The organization of rock bodies into units on the basis of their lithologic properties and their stratigraphic relations.
3. Lithostratigraphic unit. A body of rocks that is defined and recognized on the basis of its lithologic properties or combination of lithologic properties and stratigraphic relations.

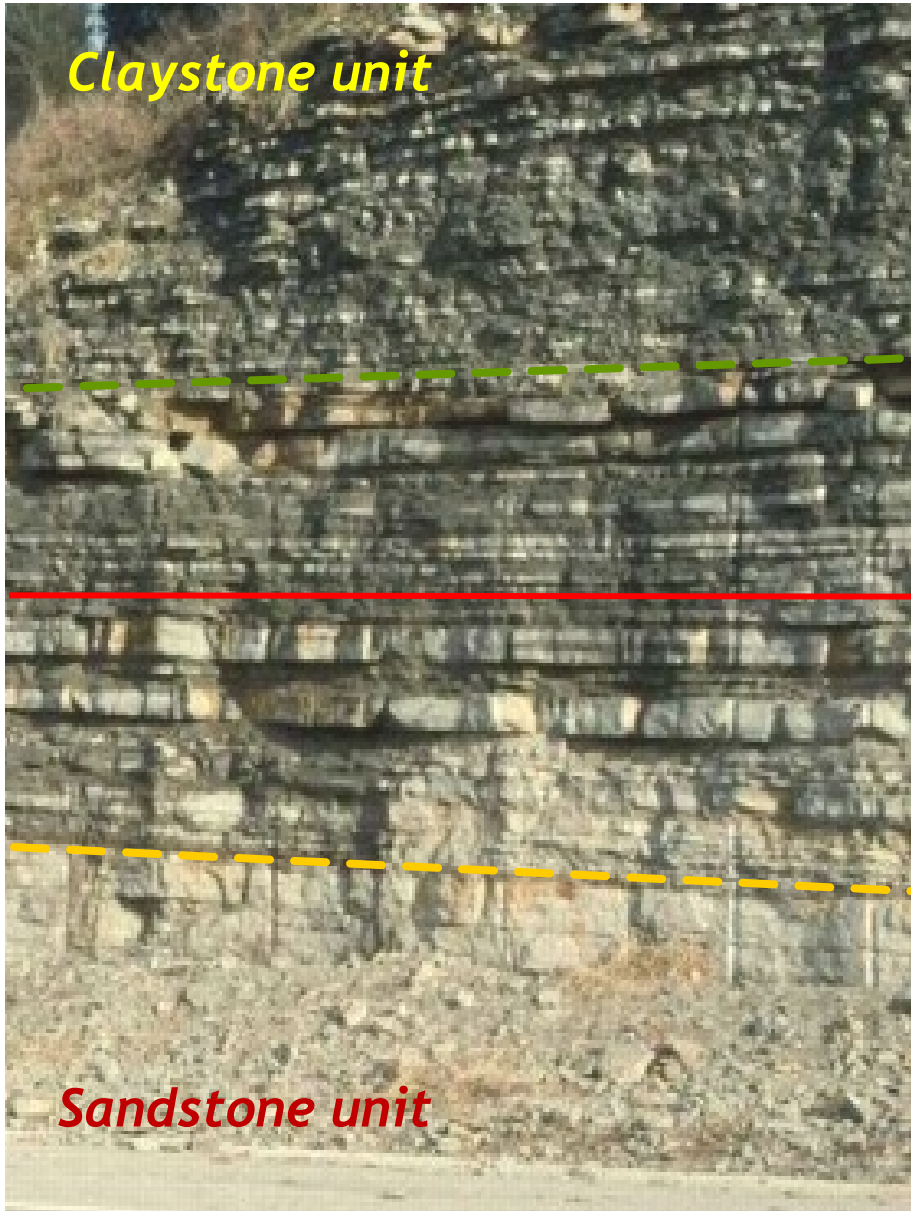
A lithostratigraphic unit may consist of sedimentary, or igneous, or metamorphic rocks.

Lithostratigraphic units are defined and recognized by observable physical features and not by their inferred age, the time span they represent, inferred geologic history, or manner of formation.

The geographic extent of a lithostratigraphic unit is controlled entirely by the continuity and extent of its diagnostic lithologic features

Lithostratigraphic units are bodies of rocks, bedded or unbedded, that are defined and characterized on the basis of their lithologic properties and their stratigraphic relations. Lithostratigraphic units are the basic units of geologic mapping.





Claystone unit

Sandstone unit

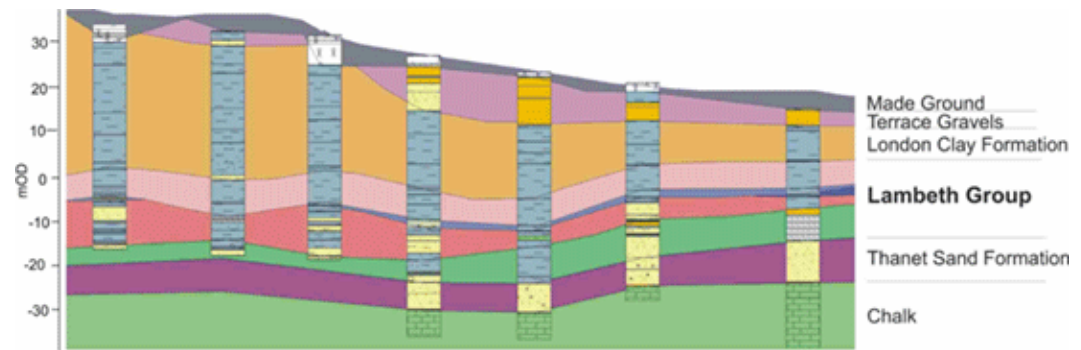
...fixed arbitrarily within zones of lithologic gradation

..this interval can be consider as another lithostratigraphic unit and known as ... **claystone - sandstone unit**...

...or boundary of claystone unit and sandstone unit "fixed arbitrarily" (red line) in the gradation boundary

LITHOSTRATIGRAPHY

- Subdivision of rock successions into units on the basis of lithology or rock type
- Lithostratigraphical standard units:
 - Supergroup
 - Group
 - Formation
 - Member
 - Bed



Key

Lambeth Group units

- Upper Mottled beds
- Laminated beds
- Lower Shelly Clay
- Lower Mottled beds
- Upnor Formation

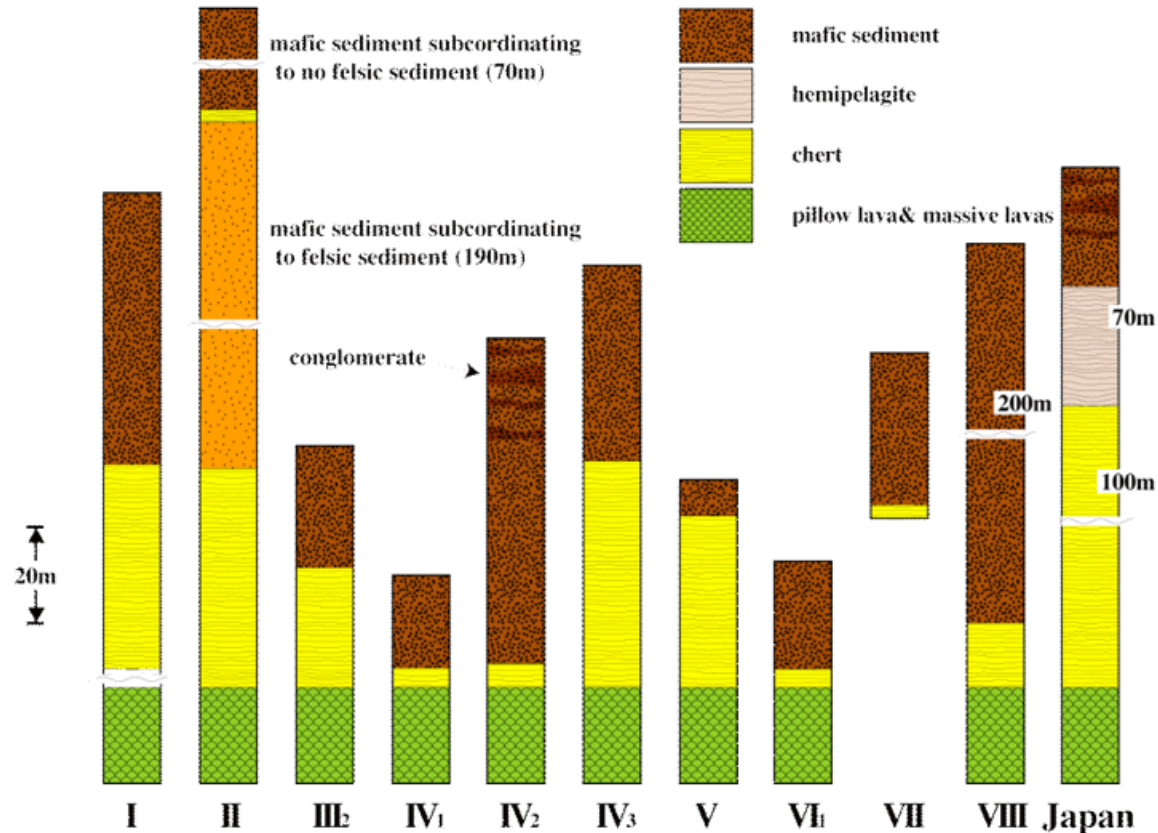
Lithology Major

- Man made deposits
- Clay
- Silt
- Sand
- Gravel
- Chalk or limestone

Lithology Minor

- Clayey
- Silty
- Sandy
- Gravelly
- Shelly or calcareous
- Peaty or lignitic

- Lithostratigraphic classification is the subdivision, classification, and organization of rock strata on the basis of their lithologic characters



Boundaries of Lithostratigraphic Unit



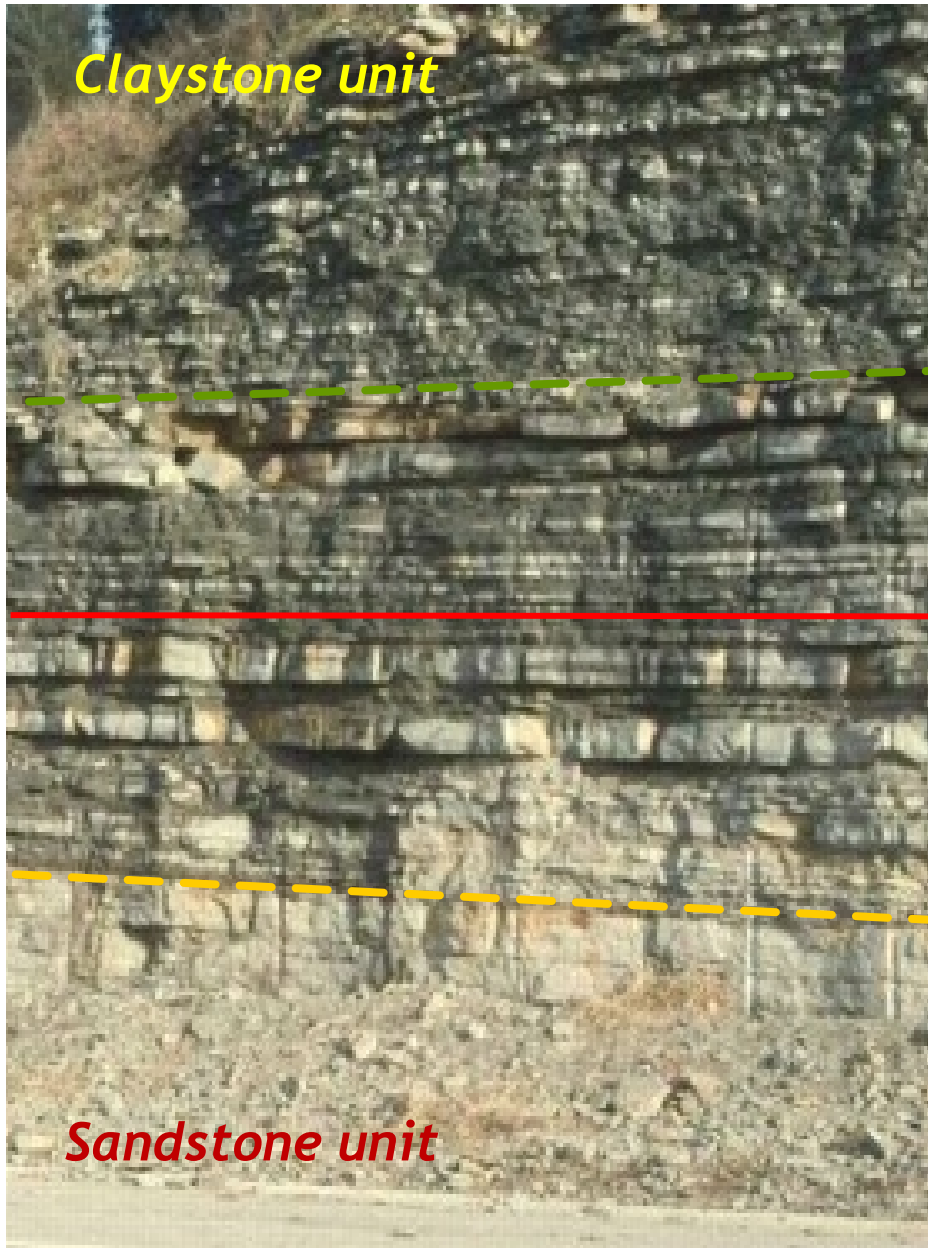
Sandstone unit



Claystone unit

B. THE FINGER OF THE GEOLOGIST IS ON A SURFACE THAT IS BOTH A PARASEQUENCE AND A PARASEQUENCE SET BOUNDARY. THE BOUNDARY IS SHARPLY DEFINED BY COALS BELOW AND BIOTURBATED, VERY FINE-GRAINED, NUMMULY TO 10'S OF CM ABOVE. THE BOUNDARY IS REMARKABLY FLAT WITH NO EVIDENCE OF TRUNCATION, EROSIONAL RELIEF, OR TRANSGRESSIVE LAG. THIS SURFACE IS TYPICAL OF PARASEQUENCE AND PARASEQUENCE SET BOUNDARIES. THE BOUNDARY IS INTERPRETED TO BE A FLOODING SURFACE. THE INTERPRETATIONS OF THE DEPOSITIONAL ENVIRONMENTS ARE SHOWN TO THE RIGHT OF PHOTO B.

- ...placed at points of lithologic change
- placed at naturally occurring sharp or distinct contact between differing lithologies



Claystone unit

...fixed arbitrarily within zones of lithologic gradation

..this interval can be consider as another lithostratigraphic unit and known as ... **claystone - sandstone unit**...

...or boundary of claystone unit and sandstone unit "fixed arbitrarily" (red line) in the gradation boundary

Sandstone unit

Supergroup	Group A	Formation A	Member A
			Member B
			Member C
		Formation B	Member D
			Member E
			Member F
		Formation C	Member G
			Member H
		Group B	Formation D
	Member J		
	Member K		
	Member L		
	Member M		
	Formation E		Member N
Member O			

Lithostratigraphic Units

Supergroup



Group



Formation



Member



Bed

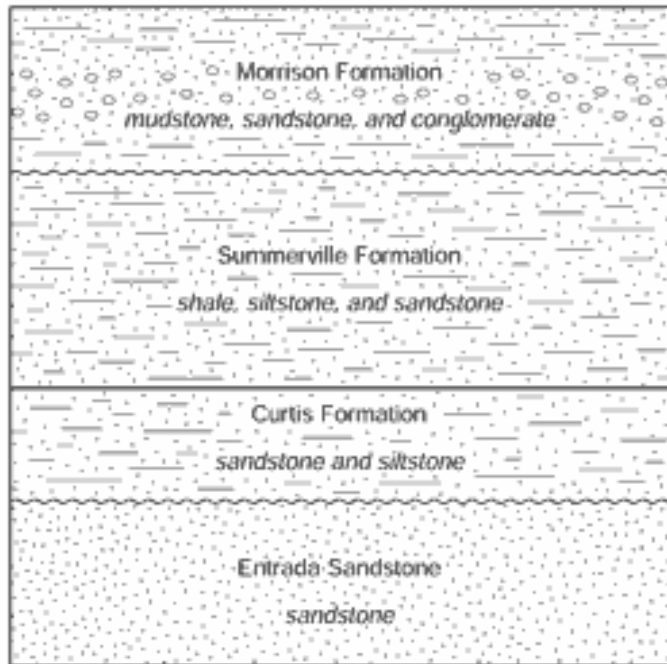
Formation

The primary formal unit of lithostratigraphic classification.

Formations are the only formal lithostratigraphic units into which the stratigraphic column everywhere should be divided completely on the basis of lithology.

The contrast in lithology between formations required to justify their establishment varies with the complexity of the geology of a region and the detail needed for geologic mapping and to work out its geologic history.

No formation is considered justifiable and useful that cannot be delineated at the scale of geologic mapping practiced in the region. The thickness of formations may range from less than a meter to several thousand meters.

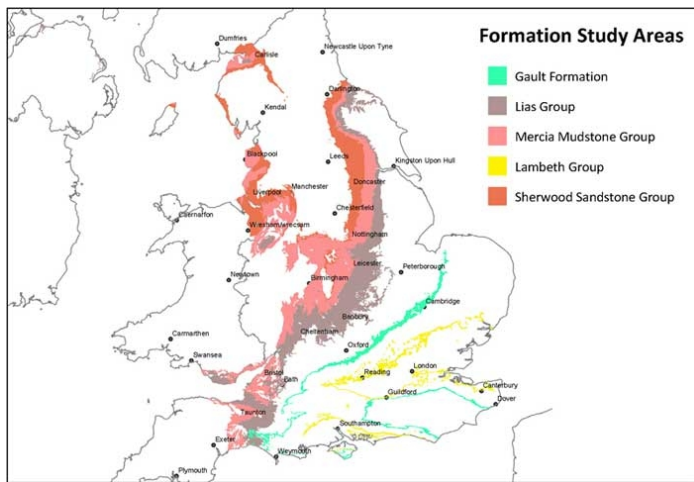


To classify and map layers of rock, geologists created a basic unit called a formation. A formation is a rock unit that is distinctive enough in appearance that a geologic mapper can tell it apart from the surrounding rock layers. It must also be thick enough and extensive enough to plot on a map.

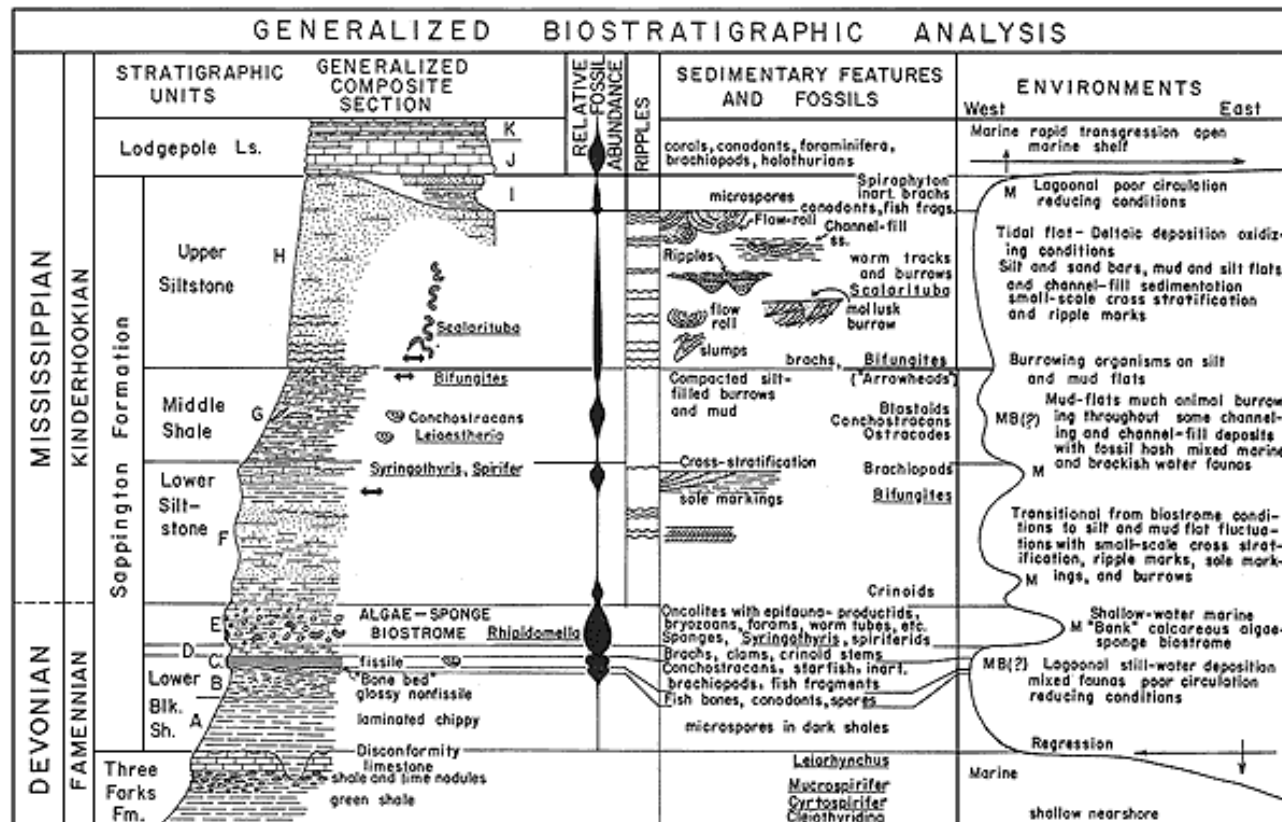
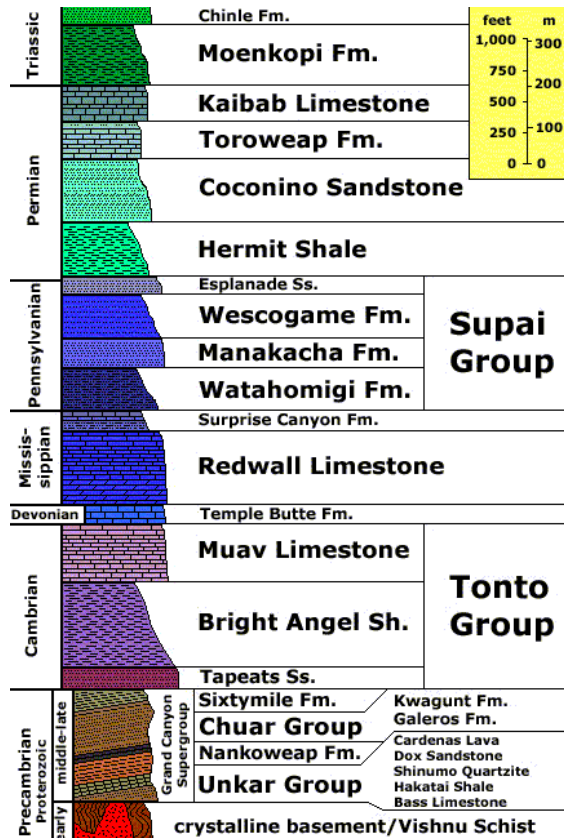
Formations are given names that include the geographic name of a permanent feature near the location where the rocks are well exposed. If the formation consists of a single or dominant rock type, such as shale or sandstone, then the rock type is included in the name.

A formation is described comprehensively by:

- name and bibliographic references;
- type area;
- stratotype (see again)
- outcrops extension
- lithological characteristics
- thick (in the stratotype)
- stratigraphic relationships (overlying formation(s); underlying formation(s); heteropyc formation(s); etc.)
- fossil content;
- age attribution;
- depositional environment;
- palaeogeographic domain;
- structural unit.



Some examples:





A view of Sibzar, Bahram and Padeha Formations at Hoz-e Dorah section (Central Iran)

- **Padeha Formation** at Hoz-e Dorah measures 90 meters in thickness and consists of a succession of calcareous sandstone, carbonaceous shale, sandstone, conglomeratic sandstone and sandy limestone.



A view of Jamal Formation at Kuh-e Sefid Donbeh section in Posht Badam region.



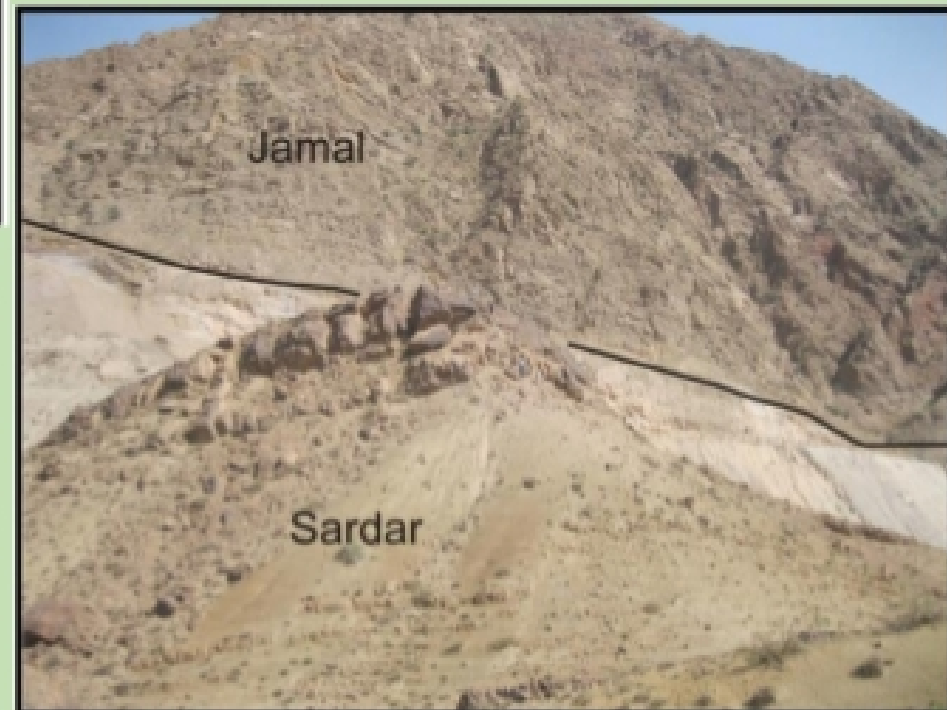
A view of Shirgesht Formation at Kashmar-Darouneh section.



A view of trilobite-bearing limestone of Shirgesht Formation at Kashmar-Darouneh section.

The rocks of Shirgesht Formation at Kashmar section includes a sedimentary succession comprising limestone and shale with sandstone intercalations having a thickness of 357 meters.

Geologic setting



Lithostratigraphic Units

Supergroup	Group A	Formation A	Member A
			Member B
			Member C
		Formation B	Member D
			Member E
			Member F
	Formation C	Member G	
		Member H	
	Group B	Formation D	Member I
			Member J
			Member K
			Member L
			Member M
			Member N
		Formation	Member O

Supergroup



Group



Formation



Member



Bed

Member.

The formal lithostratigraphic unit next in rank below a formation.

It possesses lithologic properties distinguishing it from adjacent parts of the formation.

No fixed standard is required for the extent and thickness of a member.

A formation needs not be divided into members unless a useful purpose is thus served.

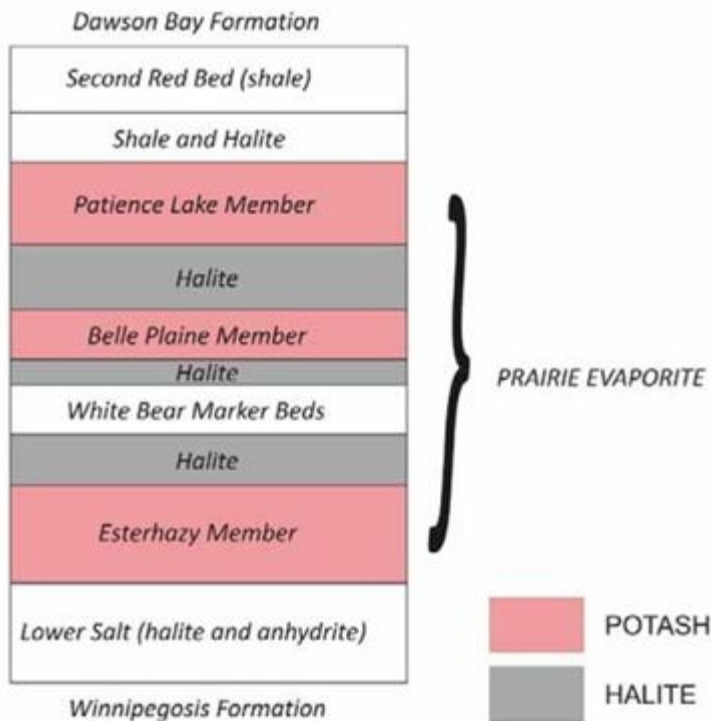
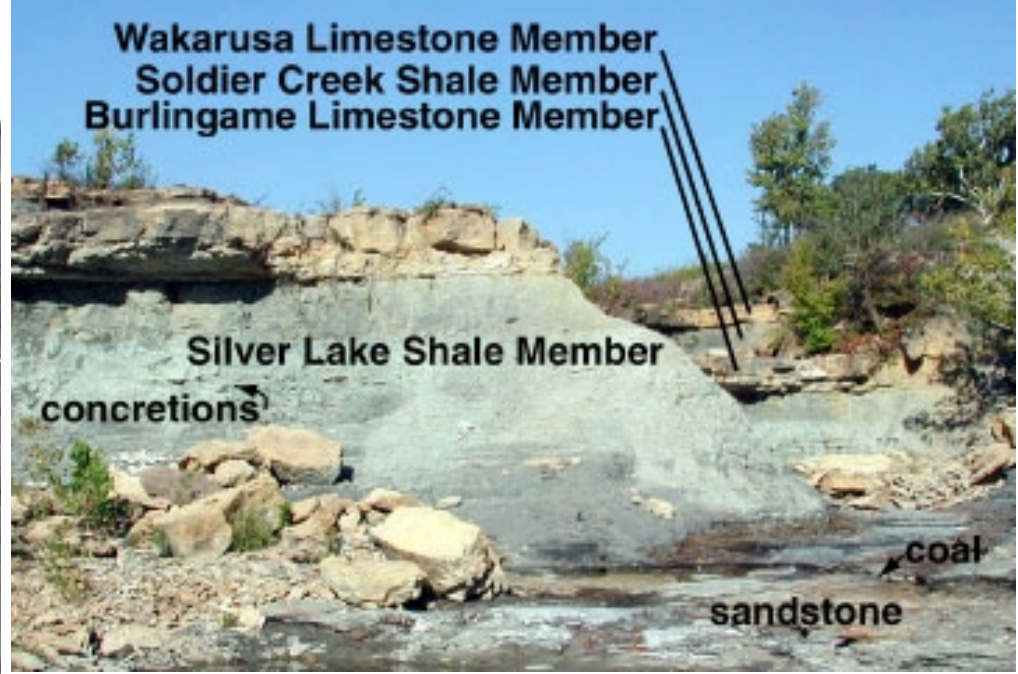
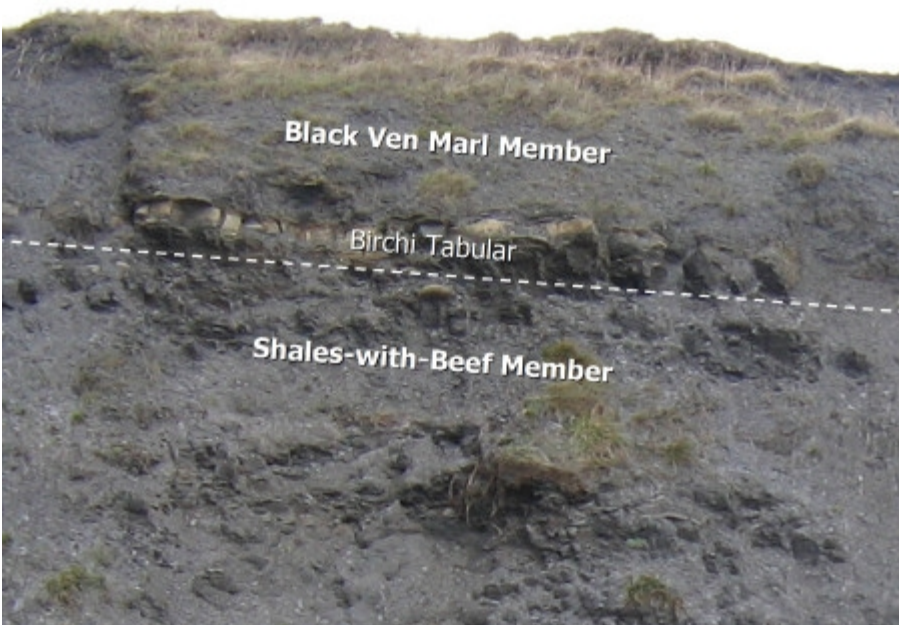
Some formations may be completely divided into members; others may have only certain parts designated as members.

A member may extend from one formation to another.

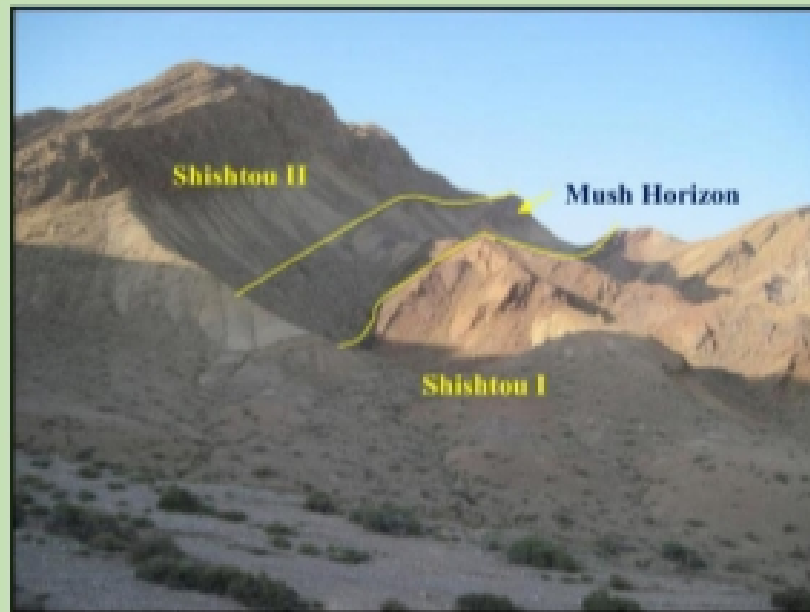
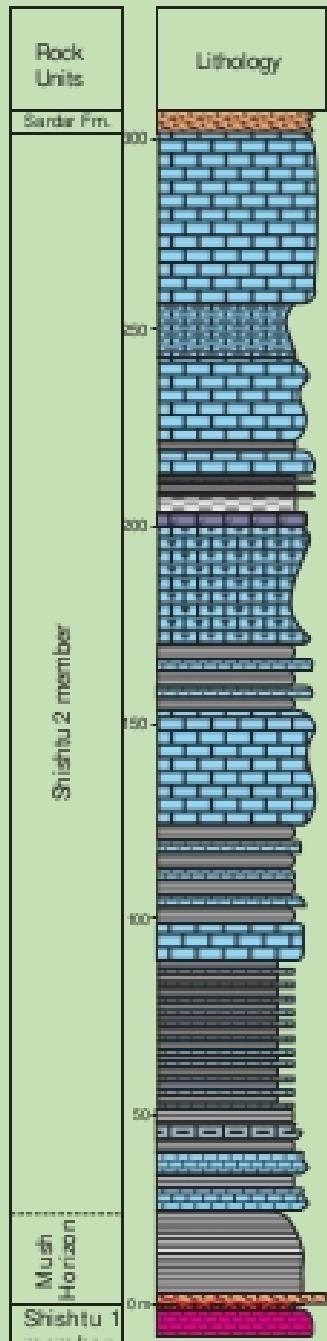
Specially shaped forms of members (or of formations) are lenses and tongues.

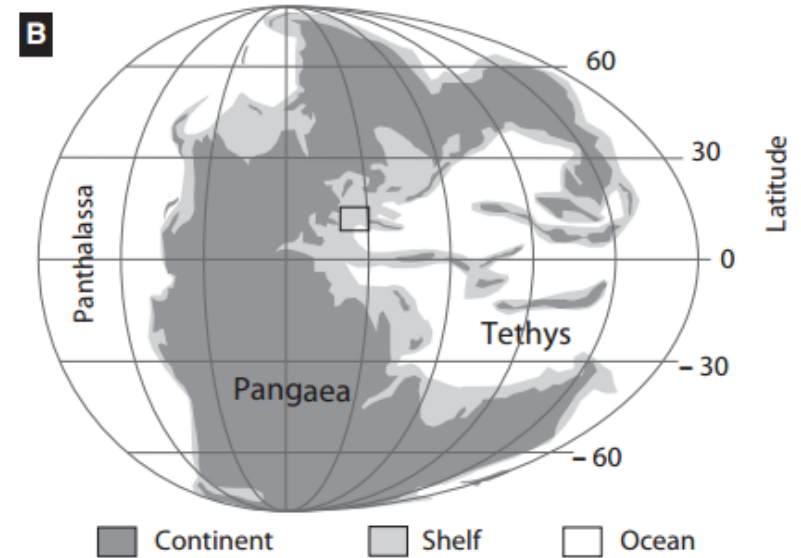
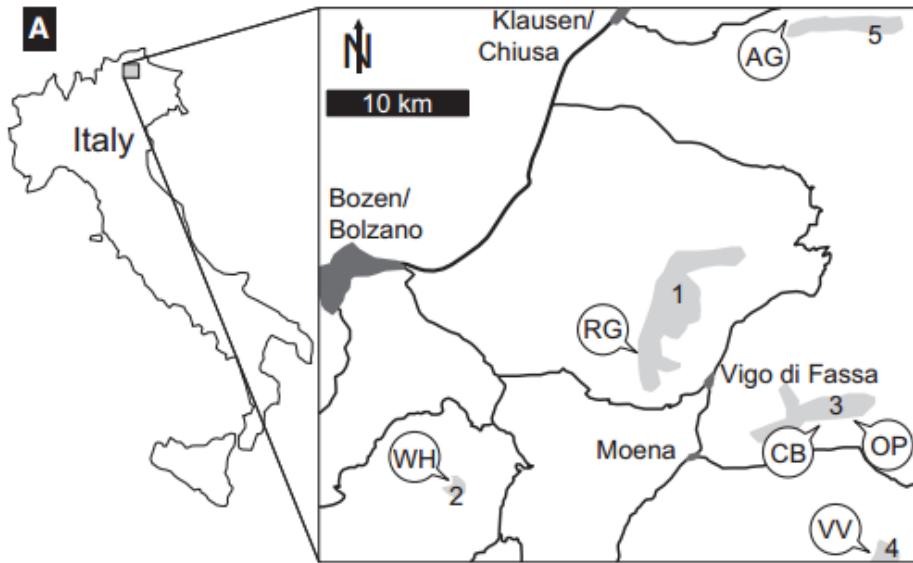
A lens is a lens-shaped body of rock of different lithology than the unit that encloses it.

A tongue is a projecting part of a lithostratigraphic unit extending out beyond its main body.

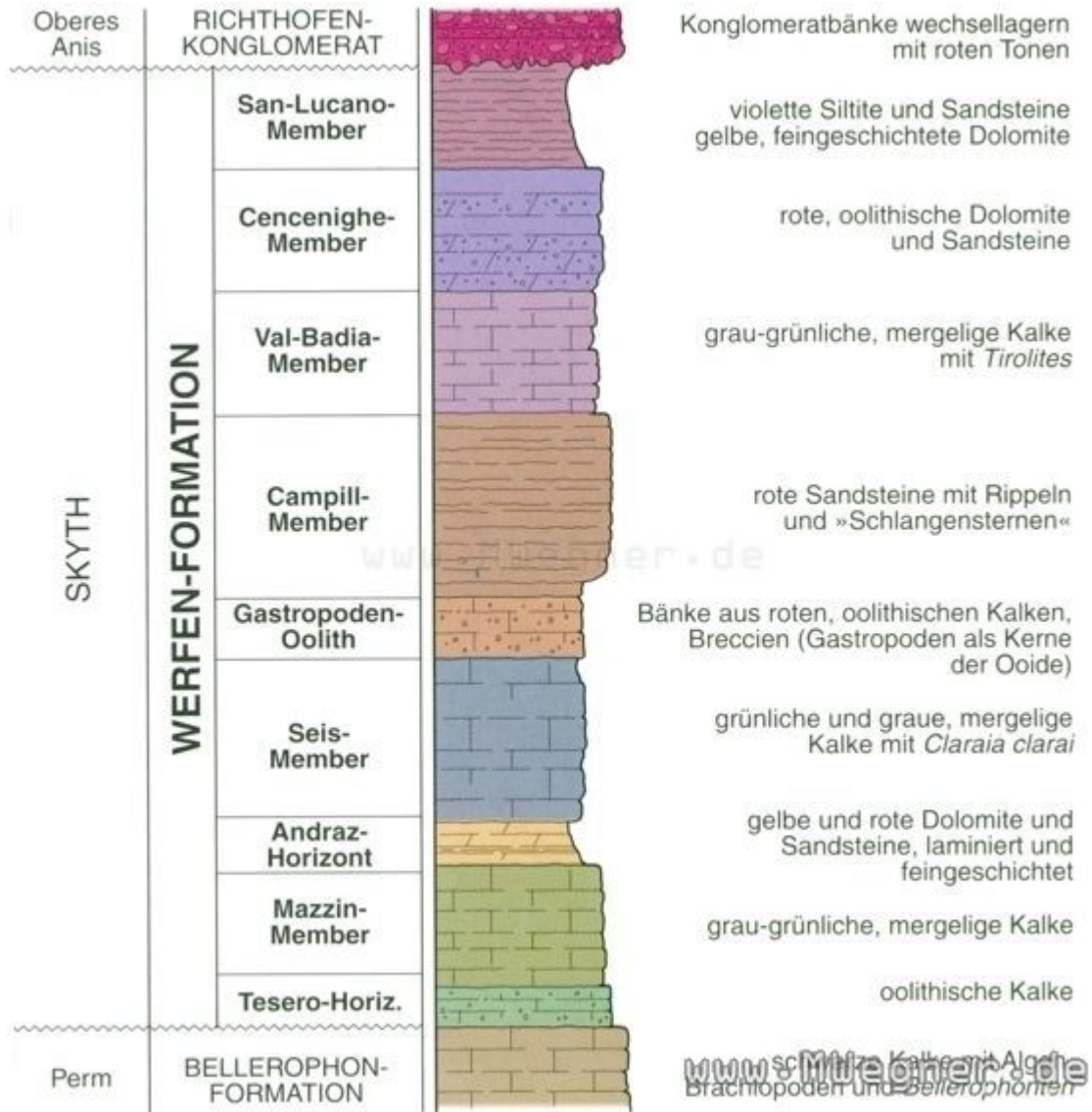


Geologic setting





A, sections of the Dolomites. RG – Rosengarten, AG – Aferer Geisler, WH – Weißhorn, CB – Costabella, OP – L’Om Picol, VV – Val Venegia. Towns in dark grey. Mountain ranges in light grey: 1 – Rosengarten group (Catinaccio), 2 – Weißhorn (Corno Bianco), 3 – Costabella Group, 4 – Pale di San Martino, 5 – Peitlerkofel group. **B**, palaeogeographical position of the dolomite region during the Early Triassic. Palaeogeographical restoration after Blakey (2012), study of Hofmann et al.)

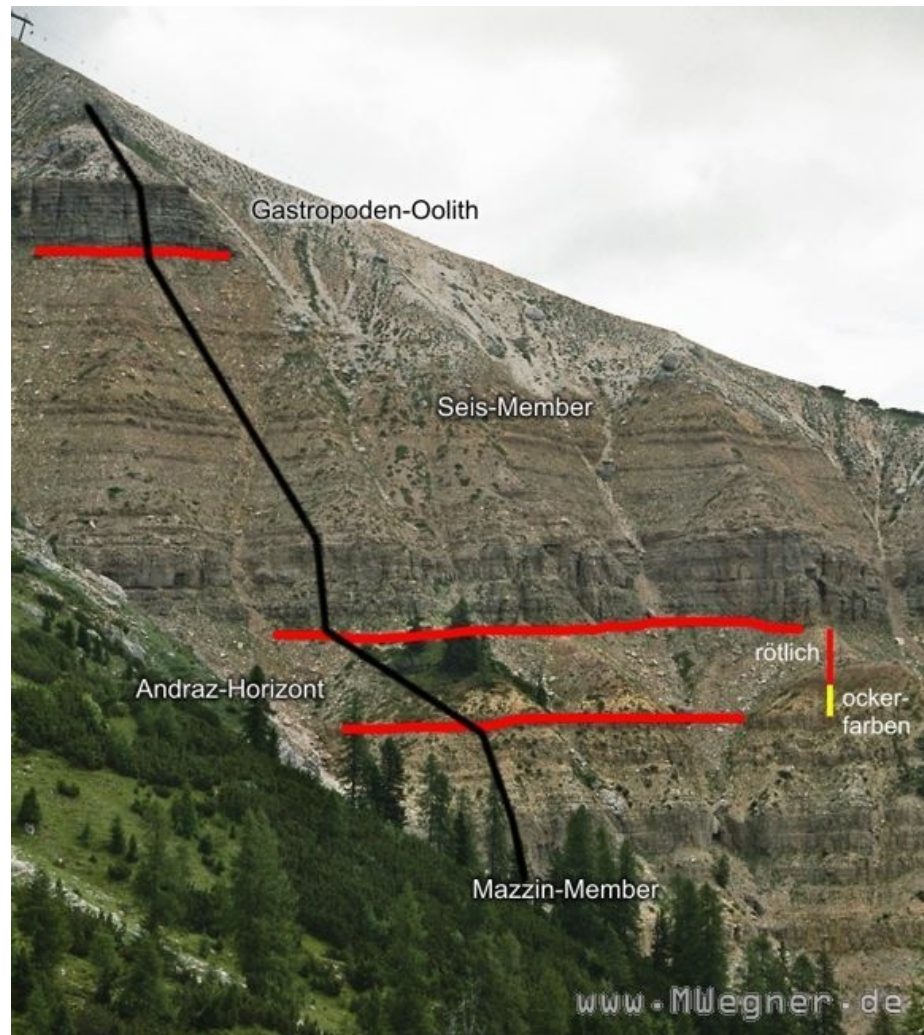
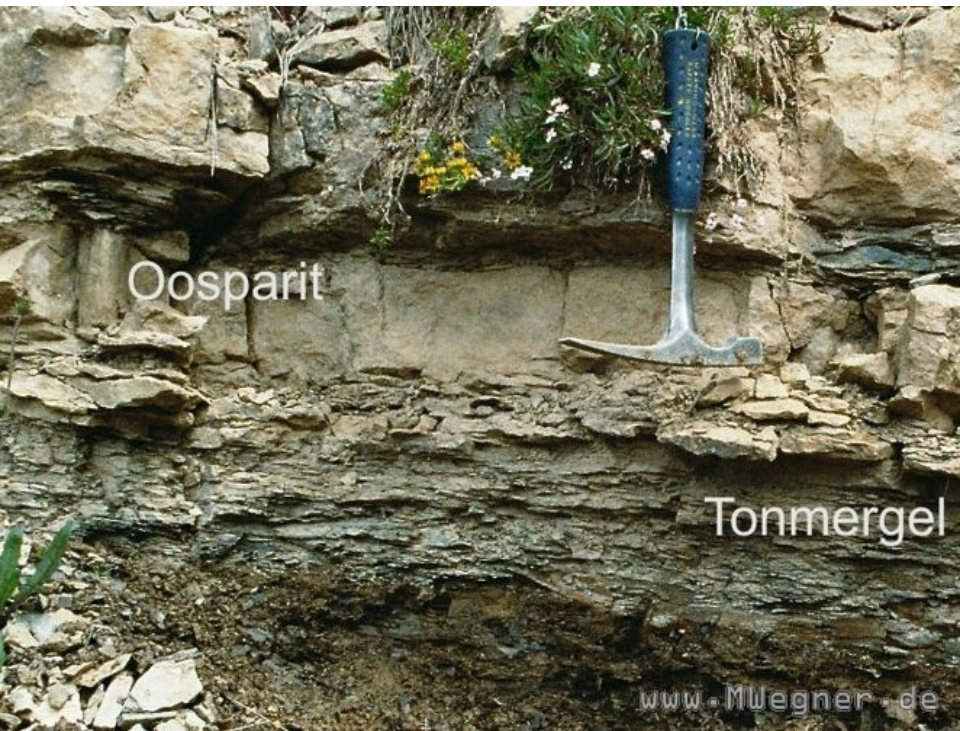


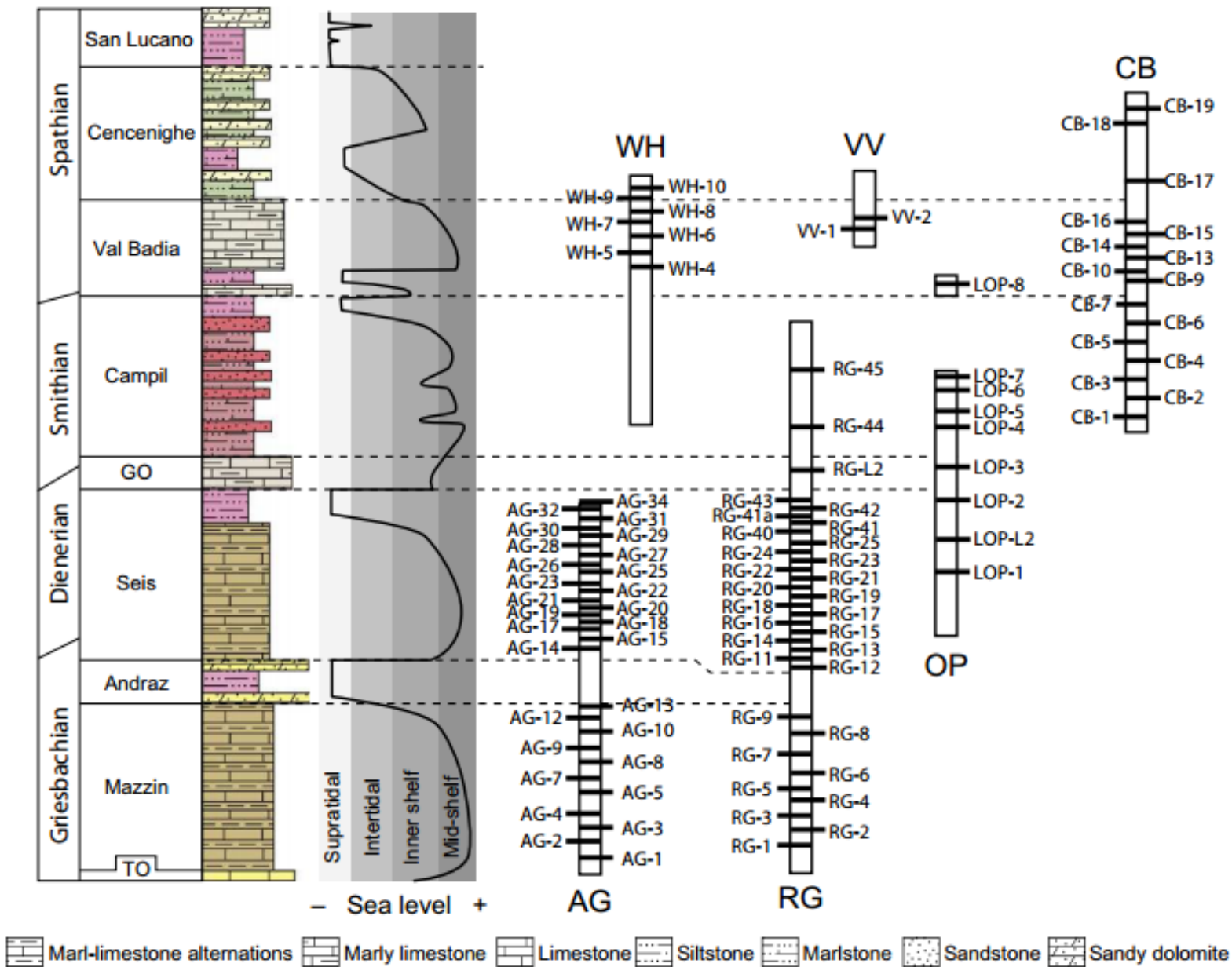
WERFEN-FORMATION

SKYTH

Perm

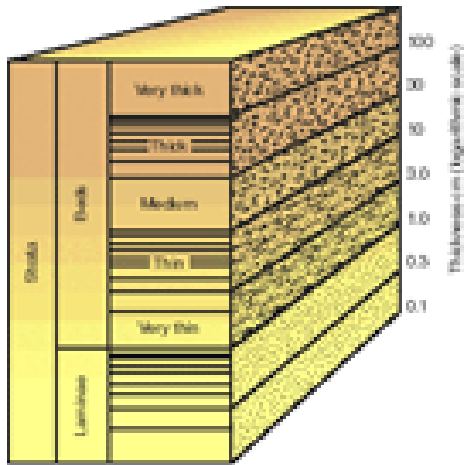
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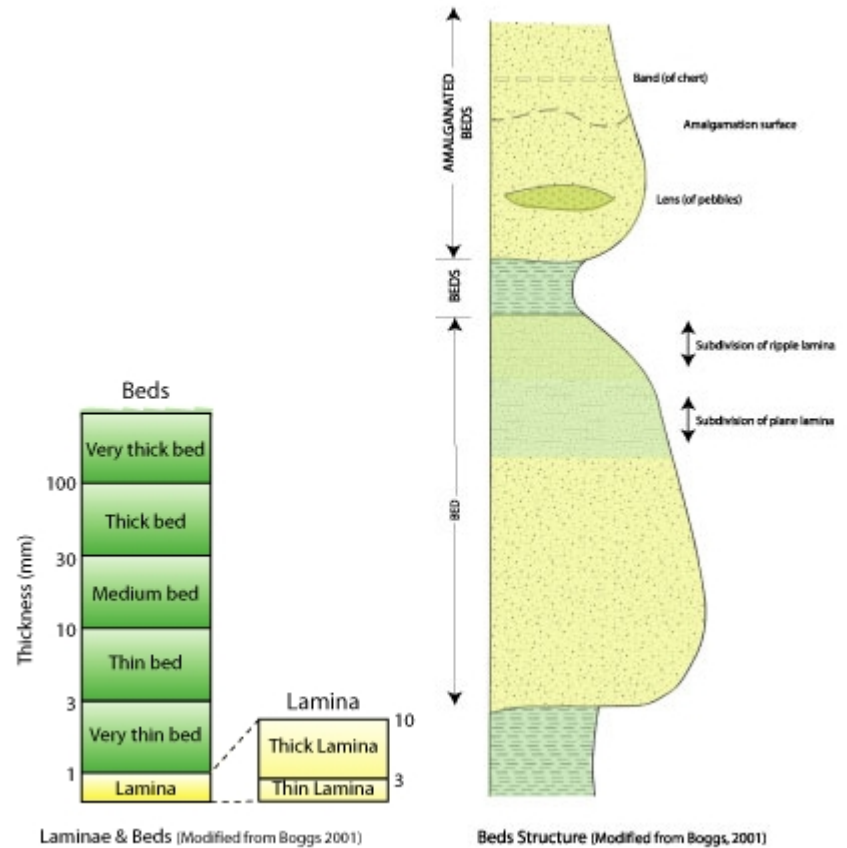
Bed.

The smallest formal unit in the hierarchy of sedimentary lithostratigraphic units, e.g. a single stratum lithologically distinguishable from other layers above and below. Customarily only distinctive beds (key beds, marker beds) particularly useful for stratigraphic purposes are given proper names and considered formal lithostratigraphic units.

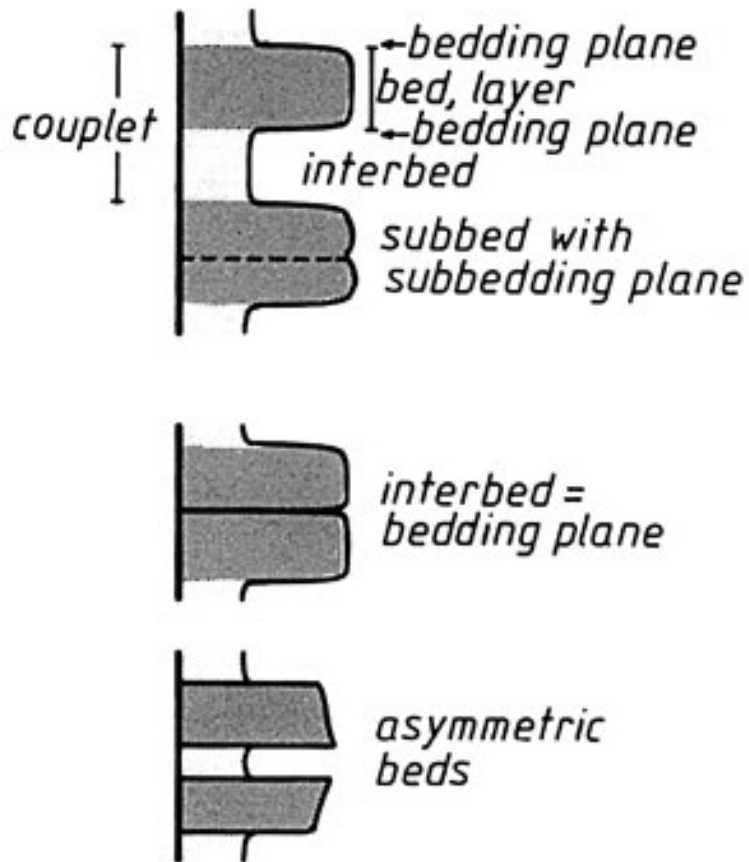


These are commonly layers of sedimentary rock separated by breaks called **bedding planes**. The sedimentary "**bed**" is the basic unit, or fundamental building block of **stratigraphy** (Campbell, 1967). The lithologic composition of

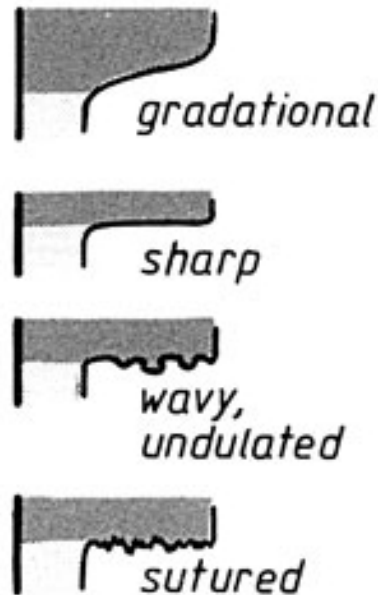
beds, their geometry, their trajectory, **stacking patterns** and hierarchies are used to interpret their depositional setting. **Beds** may signal a global process that acted over ten's of thousand of years or may be very local products of "**events**" that acted over a matter of hours or days (Einsele et al, 1991).



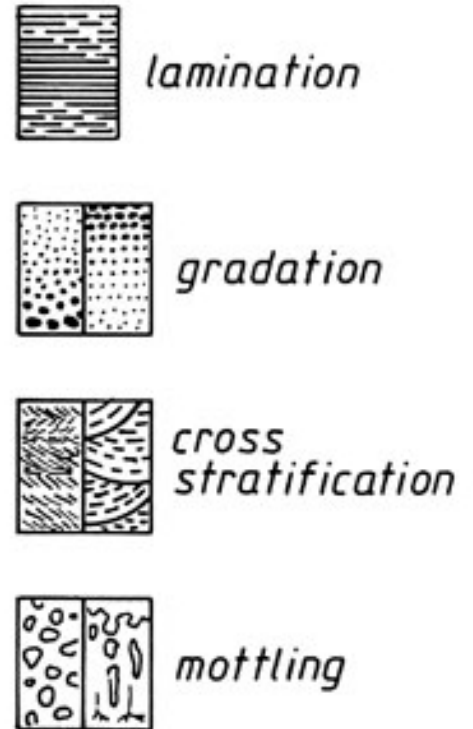
beds



bedding planes



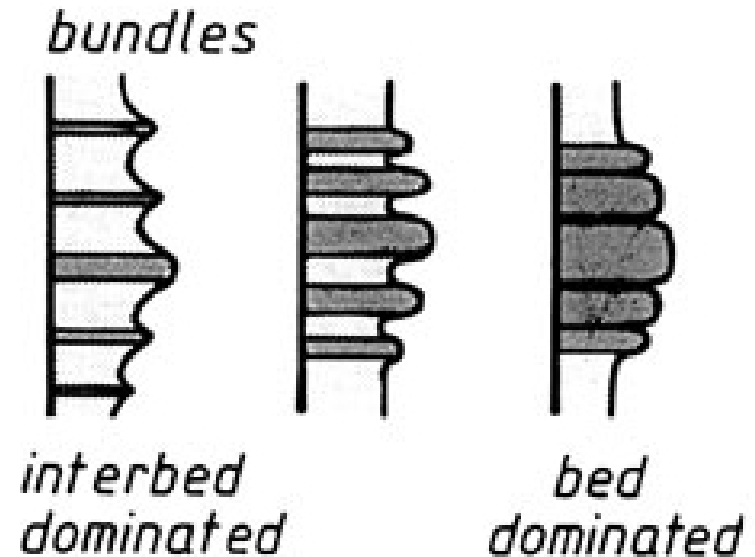
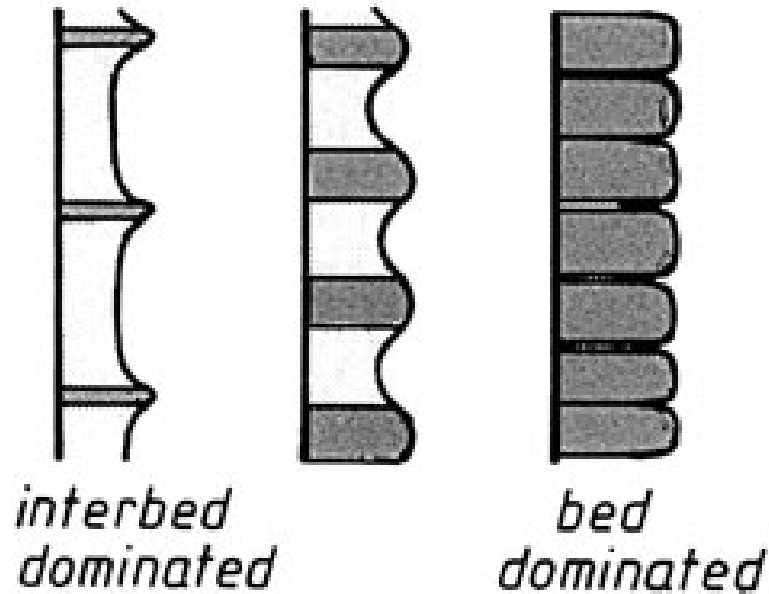
internal structures



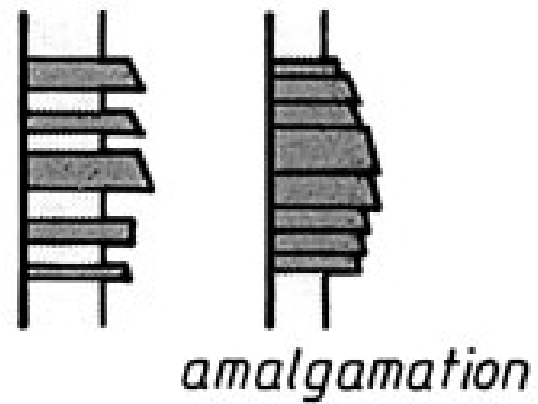
So a bed can be considered to be a relatively conformable succession of genetically related sedimentary materials, laminae or laminasets bounded by surfaces (called bedding planes or surfaces) of erosion, non-deposition or their correlative conformities. boundaries form rapidly (minutes to years) and separate all younger strata from all other strata over the extent of the surface. The time represented by bedding planes probably greater than time represented by beds (AAPG Methods in Exploration 7, 1990). The lateral extent of a bed across a terrain may capture the trajectory that sedimentary fill took during for example coastal progradation or retrogradation, hence capturing coastal trajectory.

groups of beds and interbeds

ALTERNATIONS



bedsets

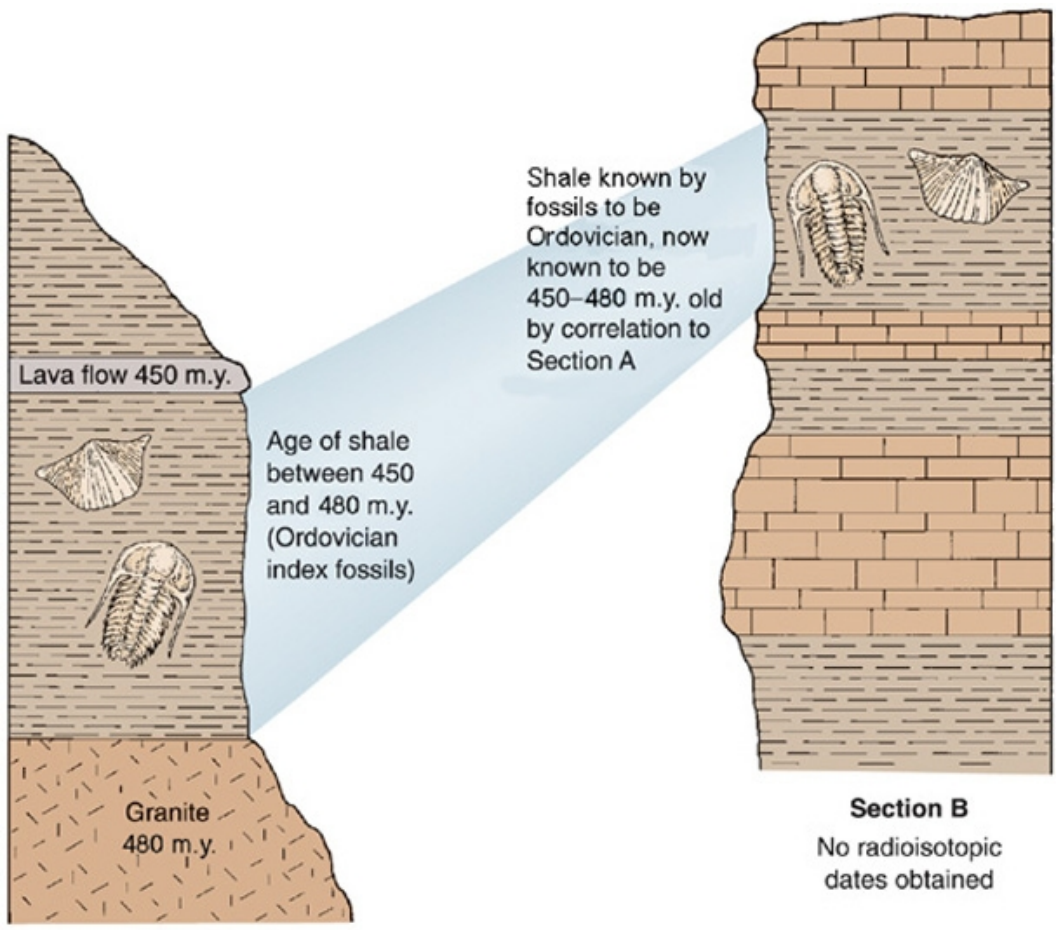


Descriptive terms for bedding phenomena

Einsele, Ricken, & Seilacher (1991)

Flow.

A discrete extrusive volcanic body distinguishable by texture, composition, or other objective criteria. The designation and naming of flows as formal lithostratigraphic units should be limited to those that are distinctive and widespread.



Section A
Some radioisotopic dates obtained

Section B
No radioisotopic dates obtained

Group.

A succession of two or more contiguous or associated formations with significant and diagnostic lithologic properties in common. Formations need not be aggregated into groups unless doing so provides a useful means of simplifying stratigraphic classification in certain regions or certain intervals. Thickness of a stratigraphic succession is not a valid reason for defining a unit as a group rather than a formation. The component formations of a group need not be everywhere the same.

Supergroup and subgroup.

The term "supergroup" may be used for several associated groups or for associated groups and formations with significant lithologic properties in common. Exceptionally, a group may be divided into subgroups.

Complex.

A lithostratigraphic unit composed of diverse types of any class or classes or rocks (sedimentary, igneous, metamorphic) and characterized by irregularly mixed lithology or by highly complicated structural relations.

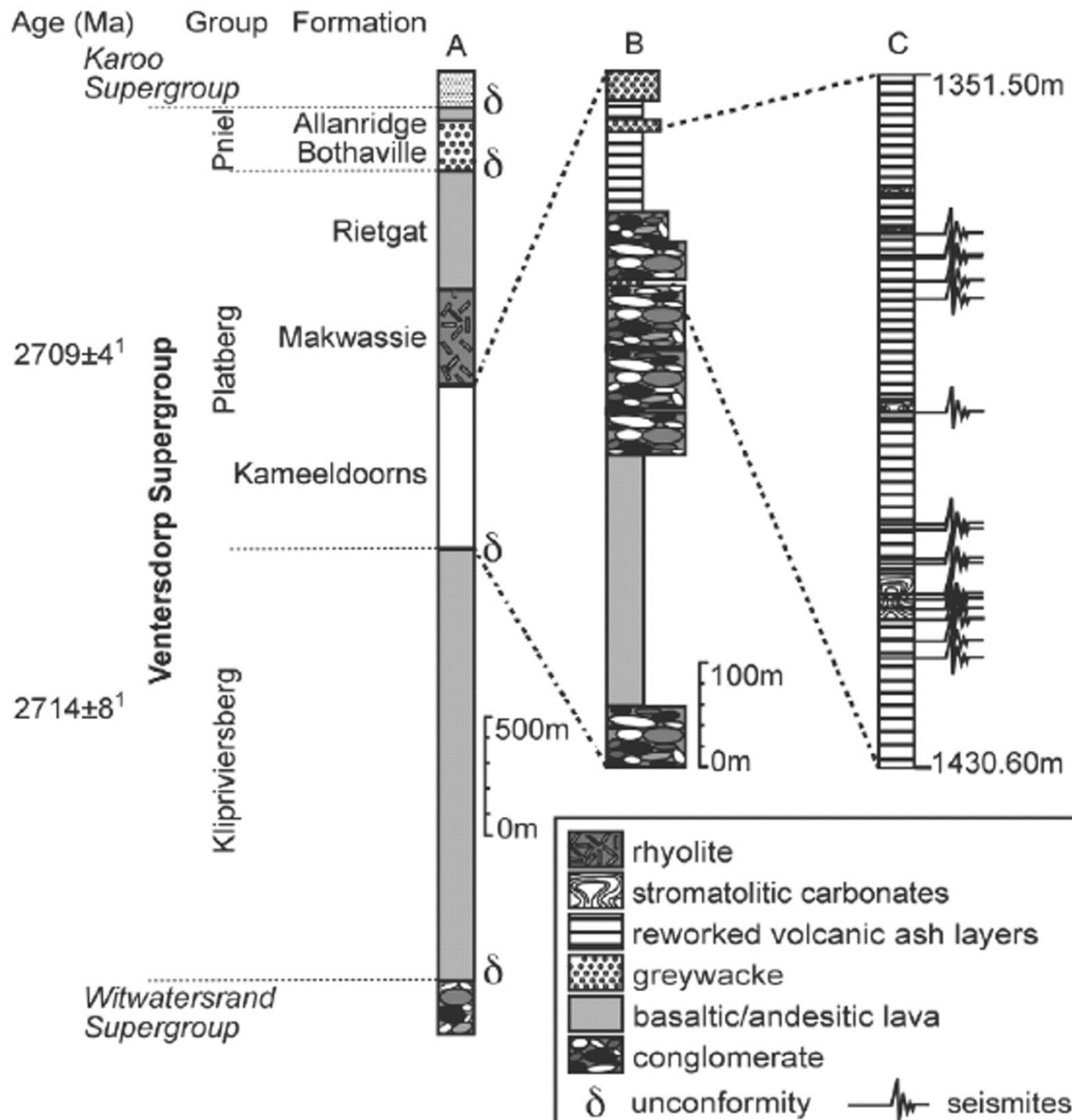


Table 2. Chronostratigraphic column for the Permian Period.

Period	Permian Period			Biostratigraphy			Lithostratigraphy		
	Epoch	Stage	Age (Ma)	Interval	Sub-Interval	Zone	Group	Sub-Group	Formation
Tr	Lower								Rio do Rasto
Permian	Lopingian	Changhsingian	251.0 ± 0.4	L	L3	Lueckisporites	Passa Dois	Irati	Teresina
		Wuchiapingian	253.8 ± 0.7						Serra Alta
	Guadalupian	Capitanian	260.4 ± 0.7						L2
		Wordian	265.8 ± 0.7		L1				Taquaral
		Roadian	268.0 ± 0.7		K		Palermo		
	Cisuralian	Kungurian	270.6 ± 0.7		J		Vittatina	Guará	Rio Bonito
		Artinskian	275.6 ± 0.7	I	Rio do Sul				
		Sakmarian	284.4 ± 0.7	H	H3	Taciba			
		Asselian	294.6 ± 0.8		H2	Itararé		Campo Mourão	
			299.4 ± 0.8	G	H1		Potonieisporites	Lagoa Azul	
C	Upper								

Lithostratigraphy

2 uses of term lithology

Study and description of physical characteristics of rocks

- Especially hand specimen and outcrop
 - e.g., investigate the lithology

Term that refers to these physical characteristics

- e.g., lithology of a stratigraphy unit- such as sandstone

Lithostratigraphy

Divide rocks on basis of lithology

Stratotype

- Designated type unit of readily accessible rocks in natural outcrops, mines or bore holes.
 - Type section
- Formal designation

Lithosome

- Masses of rock with uniform character
 - Dissolve away all other rock Sloss (1963)
- Informal designation

Lithostratigraphy

Some generalizations about lithostratigraphic units

Sedimentary, extrusive igneous, meta-sedimentary,
meta-volcanic

Generally conforms to law of superposition

Commonly stratified (layered) and tabular in form

Identification is based on observable rock characteristics

Boundaries can be either sharp and clear, or gradational

Uses of Lithostratigraphy

What lithostratigraphy can do for you

Place unit in geologic framework

Establish stratigraphic relationship with units above and below

Aid in correlation between other LITHOLOGIC units

What it CAN'T do for you

Denote time

Units of Lithostratigraphy

Lithostratigraphic classification and nomenclature

System for standardization

Fundamental unit

Formation

- Lithologically distinctive stratigraphic unit that is large enough in scale to be mappable at the surface or traceable in the subsurface.
- May be just 1 lithosome or multiple
- Subdivision of formation

Lithostratigraphy

Other formal lithostratigraphic units

Smaller than a formation

- Member
 - Subdivision of a formation
- Bed
 - Smallest formal lithostratigraphic unit

Collections of formations

- Group
 - 2 or more adjacent formations that have some unifying lithological and/ or genetic features
- Supergroup
 - Groups of groups
 - » e.g., Newark Supergroup

Stratigraphic Contacts

Contacts

Plane or irregular surfaces between different types of rocks

Separate units

Conformable

Unconformable

Procedures for establishing Lithostratigraphic Units

Stratotypes and type localities as standard of definition.

- Each formal lithostratigraphic unit should have a clear and precise definition or characterization.
- The designation of a stratotype for a layered unit or a type locality for a nonlayered unit is essential.
- Designation of auxiliary reference sections or additional type localities may be used to supplement the definition of a lithostratigraphic unit.
- Where a complete section of a unit does not crop out in an area, the lower and upper boundary-stratotypes at specific sections are designated.

Boundary-defining stratotypes

- The boundary-defining function of a stratotype is performed by the unit stratotype and boundary stratotype (Salvador, 1994, pp. 26–27).
- These stratotypes are used mainly for defining the boundaries of lithostratigraphic, unconformity-bounded, and geochronologic/chronostratigraphic units.
- Unit stratotypes are most commonly used to define the boundaries of lithostratigraphic units, where, for example, the lower and upper contacts of a newly recognized formation are explicitly defined in a single, physically superposed type section.

The range-zone of a fossil taxon cannot be fixed by a stratotype.

Those kinds of stratigraphic units which are defined by features subject to change with new discoveries or new interpretations do not lend themselves to definitions by boundary-stratotypes

Exemplary stratotype or reference section

- A function of a stratotype is to provide a concrete example of an author's concept of a given stratigraphic unit, but without necessarily using that section to define the boundaries of the unit or even to name the unit.
- As interpretations change, an exemplary stratotype can be abandoned without abandoning the name of the stratigraphic unit for which it was supposed to be an example.
- Exemplary stratotypes have often been used in the context of **biostratigraphic units**, but are also applicable to all other categories of material stratigraphic units. **Unlike boundary-defining and nominal stratotypes, exemplary stratotypes are not applicable to time units**, because no material stratigraphic section can be an example of a span of time. **Thus, a given section can be an exemplary stratotype of the Maastrichtian Stage, but not of the Maastrichtian Age.**
- Stratigraphic units have many different attributes (lithology, thickness, fossil content, sedimentary structures, etc.), and it is unlikely that any one local section can display the best examples of all of these attributes. In addition, future sections may be discovered that show even better examples of the stratigraphic unit, such that there is really nothing sacred about an exemplary stratotype as such.

Nominal stratotype

- Nominal stratotypes are analogous to name-bearing types (nominal taxa and holotypes) in biology and paleontology (International Commission on Zoological Nomenclature [ICZN], 1999, pp. 63–64; 120).

- **Nominal stratotypes deal with the priority and applicability of stratigraphic names.**

For example, if the Original Formation was properly named and stratotypified, a later geologist cannot just arbitrarily call this unit the Newfangled Formation because he likes the name better. In principle, bproperly stratotypified would mean that a specific stratigraphic section is described and designated as name-bearer in an appropriate publication (cf. NACSN, 1983, Article 7b). However, if the Original Formation had never been properly stratotypified, then later geologists are not necessarily compelled to use this name (cf. NACSN, 1983, Article 7c).

- Taxonomic analogies: concepts of *nomen nudum* and *nomen dubium*

Hierarchical classification of stratotypes with their major functions defined (from Walsh, 2005)

Stratotype—A specific stratigraphic section or local or regional body of rock used to define the boundaries of, and/or to exemplify, and/or to bear the name of a particular stratigraphic or temporal unit.

1. **Boundary-defining stratotype**—A specific stratigraphic section in which one or two specified horizons are used to define one or both boundaries of a particular stratigraphic or temporal unit. Such boundary definitions may be permanent or subject to modification with new data.

A. **Unit stratotype**—A specific, physically superposed stratigraphic section whose designated base and top are used to define both the base and the top of a particular stratigraphic unit, and/or both the beginning and the ending of a particular temporal unit. The base and top of a strict unit stratotype are defined by permanent golden spikes.

B. **Boundary stratotype**—A specific stratigraphic section in which one specified horizon is used to define the base or top of a particular stratigraphic unit, and/or the beginning or ending of a particular temporal unit. The specified defining horizon in a strict boundary stratotype is defined by a permanent golden spike.

2. **Exemplary stratotype**—A specific stratigraphic section used to serve as a concrete example of an author's concept of one or more attributes of a particular stratigraphic unit.

3. **Nominal stratotype**—A specific stratigraphic section or local or regional body of rock used to serve as the name-bearer of a particular stratigraphic and/or temporal unit.

A. **Strict nominal stratotype**—A nominal stratotype, all of which must always be included in the concept denoted by the name of the stratigraphic or temporal unit which it bears.

B. **Loose nominal stratotype**—A nominal stratotype, at least some part of which must always be included in the concept denoted by the name of the stratigraphic or temporal unit which it bears.

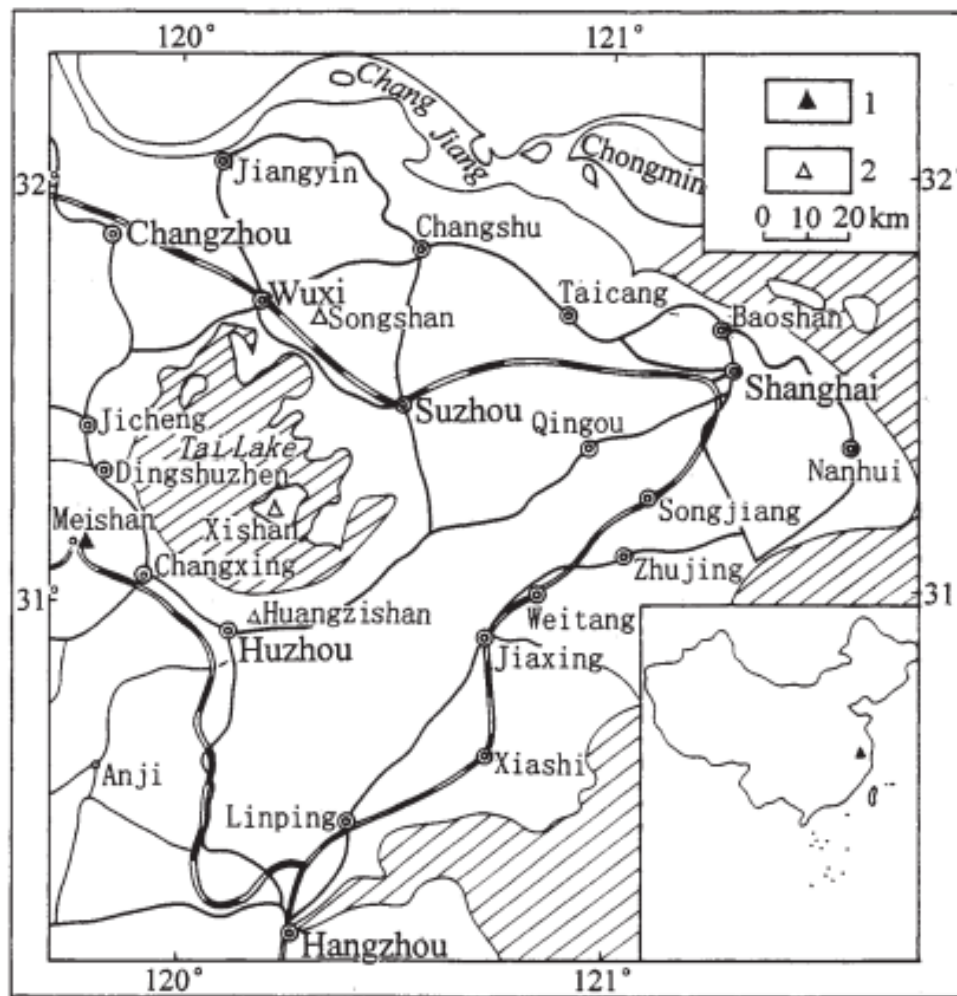
The Global Stratotype Section and Point (GSSP) of the Permian-Triassic Boundary

by Yin Hongfu¹, Zhang Kexin¹, Tong Jinnan¹, Yang Zunyi² and Wu Shunbao¹

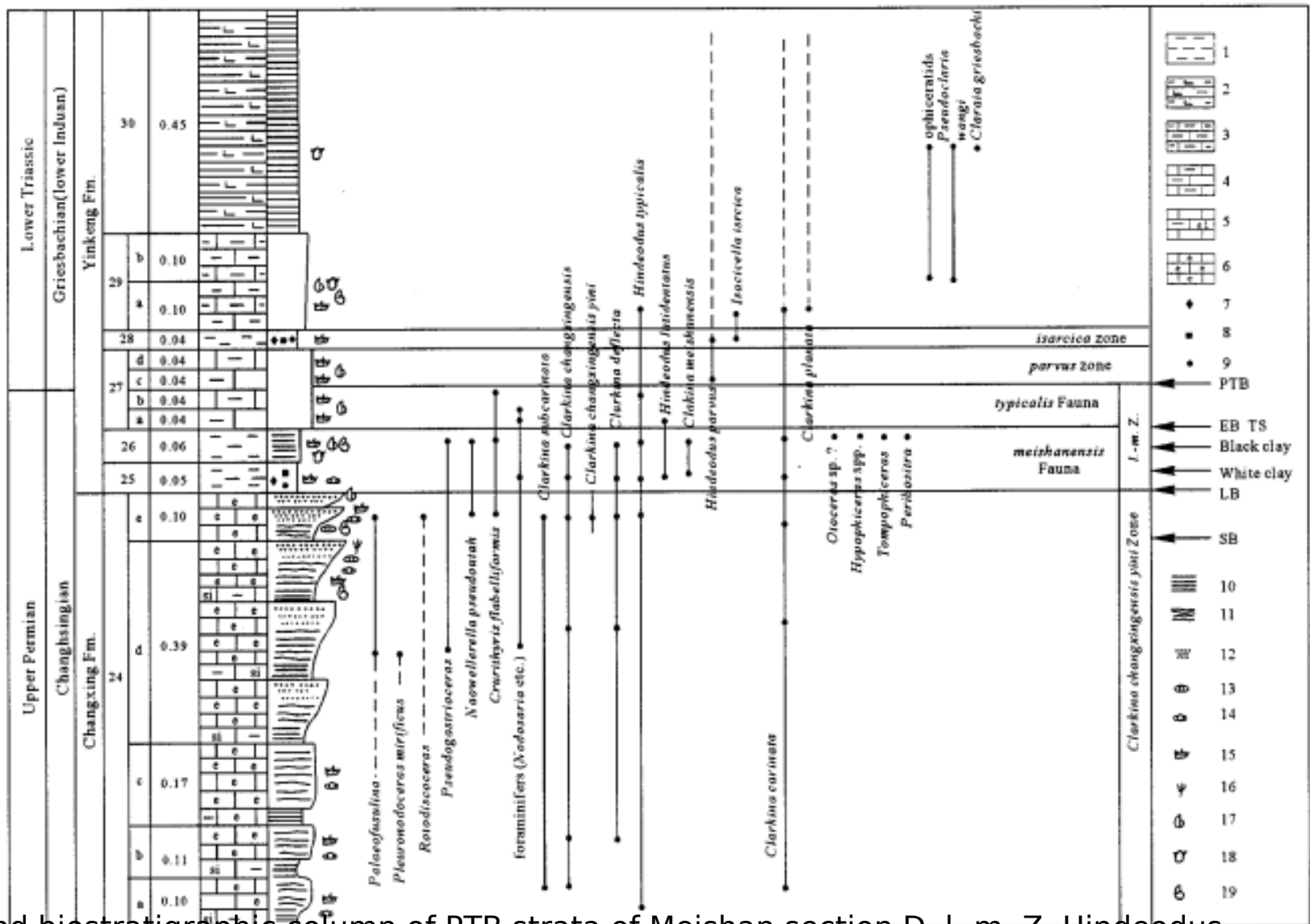
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1. Faculty of Earth Science, China University of Geosciences, Wuhan 430074, China.

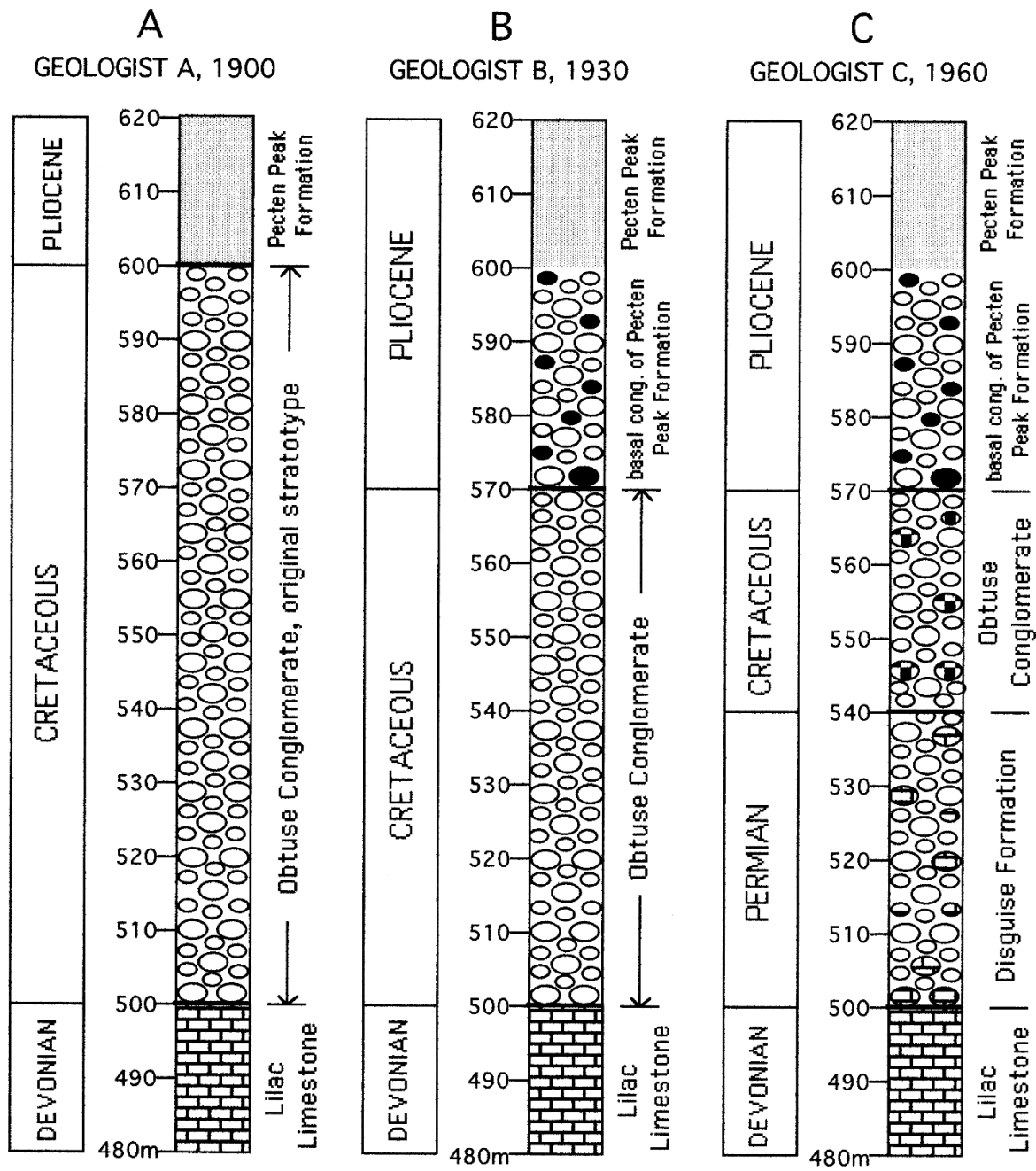
2. Faculty of Earth Science, China University of Geosciences, Beijing 100083, China.



Regional map of Lower Yangtze. 1. Meishan section, the GSSP of the Permian-Triassic boundary; 2. Accessory section of the Permian-Triassic boundary



Litho- and biostratigraphic column of PTB strata of Meishan section D. I. m. Z. *Hindeodus latidentatus*-*Clarkina meishanensis* Zone, SB sequence surface, LB lithostratigraphic boundary, EB eventostratigraphic boundary, TS transgressive surface, PTB Permian-Triassic boundary. 1. clay, 2. calcareous mudrock, 3. marl, 4. argillaceous micrite, 5. siliceous micrite, 6. bioclastic micrite, 7. high quartz, 8. zircon, 9. microsphaerules, 10. horizontal bedding, 11. wavy bedding, 12. convolute bedding, 13. fusulinids, 14. foraminifers, 15. conodonts, 16. calcareous algae, 17. brachiopods, 18. bivalves, 19. ammonoids.



(from Walsh, 2005)

KIND OF STRATOTYPE	CIRCUMSTANCES INVOLVED IN DESIGNATING	POSSIBLE FUNCTIONS
Holostratotype	A strict nominal stratotype designated by the original author at the time of the original formal publication and naming of the stratigraphic unit.	name-bearing* boundary-defining exemplary
Parastratotype	A supplementary stratotype designated in the original publication of the holostratotype, used to illustrate the diversity or heterogeneity of the stratigraphic unit or some critical feature not evident in the holostratotype.	boundary-defining exemplary*
Lectostratotype	A stratotype for a previously described stratigraphic unit selected later in the absence of an adequately designated original stratotype.	name-bearing boundary-defining exemplary
Neostratotype	A new stratotype selected to replace an older one which has been destroyed, covered, or otherwise made inaccessible.	name-bearing boundary-defining exemplary
Hypostratotype	A stratotype proposed after the original designation of the holostratotype (and parastratotype) in order to extend knowledge of the unit or boundary to other geographic areas.	exemplary*

Reference

Salvador, A (Editor) 1994, International Stratigraphic Guide: A guide to stratigraphic classification, terminology, and procedure. 2nd edition. International Union of Geological Sciences and the Geological Society of America, Boulder, Colorado.

Stratotypes and biostratigraphic units

The designation of boundary-defining stratotypes for biostratigraphic units with binomial names is logically possible but essentially pointless, because the boundaries of such entities frequently change with new interpretations. Such units are therefore better characterized by exemplary stratotypes.

For the following reasons, biostratigraphic units with binomial names cannot have nominal stratotypes:

- Genus and species names change frequently in paleontology owing to taxonomic revisions and routine re-identifications, so the taxonomic names of many biostratigraphic units cannot be fixed by designating a stratotype.
- our concepts of the taxa used to define a given biostratigraphic zone might change so much over time that any original binomial stratotype for that zone might eventually be excluded from the thickness of strata now delimited by our revised concepts of those taxa.
- A given stratum or thickness of strata might be simultaneously assignable to numerous equally legitimate biostratigraphic zones, the binomial name of any one biostratigraphic zone cannot assume nomenclatural priority over any other.

Procedures for Extending Lithostratigraphic Units - Lithostratigraphic Correlation

A lithostratigraphic unit and its boundaries are extended away from the type section or type locality only as far as the diagnostic lithologic properties on which the unit is based may be identified.

1. Use of indirect evidence for identification of units and their boundaries. Where lithologic identity is difficult to determine because of poor or no outcrops, a lithostratigraphic unit and its boundaries may be identified and correlated on the basis of indirect evidence: geomorphic expression, wire-line logs, seismic reflections, distinctive vegetation, etc.

2. Marker beds used as boundaries. The top or the base of a marker bed may be used as a boundary for a formal lithostratigraphic unit where the marker bed occurs at or near a recognizable vertical change in lithology.

Naming of Lithostratigraphic Units.

1. General. The name of lithostratigraphic units follows the general rules for naming stratigraphic units.

In the case of lithostratigraphic units, a **simple lithologic term** indicating its dominant rock type may be used instead of the unit-term indicating its rank (**group, formation, member, bed**).

However, the use of **the unit-term is preferable**; and the use of both the lithologic term and the unit-term should be discouraged. **The terms "lower", "middle", and "upper" should not be used for formal subdivisions of lithostratigraphic units.**

2. Geographic component of name.

In the case of lateral changes in lithologic composition, change in the geographic term is desirable for important regional changes, but the indiscriminate proposal of new names for minor lithologic variations is undesirable.

Geographic component of names of stratigraphic units

i. Source. Geographic names should be derived from permanent natural or artificial features at or near which the stratigraphic unit is present.

A name should be on standard published maps of the pertinent political jurisdiction.

Where such names are not available, the place from which the name is derived should be described and shown on an appropriately scaled map accompanying the description of the new unit.

Short names are preferable to long or compound names.

The name of the stratigraphic unit should be exactly the same as the name of the geographic feature after which it is named.

ii. Spelling of Geographic Names. The spelling of the geographic component of the name of a stratigraphic unit should conform to the usage of the country of origin. The spelling of the geographic component, once established, should not be changed. The rank or lithologic component may be changed when translated to a different language.

iii. Changes in Geographic Names. The change in the name of a geographic feature does not affect the name of the associated stratigraphic unit nor does disappearance of the geographic feature require a new name.

iv. Inappropriate Geographic Names. A geographic name should not be misleading, e.g. London Formation for a unit in Canada, although a city with that name exists in Canada.

v. Duplication of Geographic Names. The name of a new stratigraphic unit should be unique in order to prevent ambiguity. The IUGS Lexique Stratigraphique International and national and regional lexicons contain lists of previously used names and inquiry to geological surveys and other regional organizations is recommended to discover previously used names not yet published in the lexicons.

vi. Names for subdivisions of Stratigraphic Units. If a unit is divided into two or more formal component units, the geographic name of the original unit should not be employed for any of the subdivisions.

Unit-term Component of Names of Stratigraphic Units. The unit-term component of a stratigraphic name indicates the kind and rank of the unit. A stratigraphic unit-term may differ in different languages.

Relation of Names to Political Boundaries. Stratigraphic units are not limited by international boundaries and should not differ across them.

Reduction in number of names through correlation. If correlation has established the identity of two differently named stratigraphic units, the later name should be replaced by the earlier, other considerations being equal.

Uncertainty in Assignment. If identification of a stratigraphic unit is in doubt, that uncertainty should be expressed in the nomenclature employed. The following conventions may be used:

Devonian? = doubtfully Devonian

Macoa? Formation = doubtfully Macoa Formation

Peroc-Macoa formation = strata intermediate in position (horizontally or vertically) between two stratigraphic units

Silurian-Devonian = one part Silurian, one part Devonian

Silurian or Devonian = either Silurian or Devonian

Silurian and Devonian = both Silurian and Devonian, but undifferentiated.

The name of the older or lower unit, if this distinction can be made, should always come first when two units are hyphenated or used in combination.

Abandoned Names. The name of a stratigraphic unit, once applied and then abandoned, should not be revived except in its original sense. Reference to abandoned names should indicate the original sense in which the name was used, e.g. "Mornas Sandstone of Hebert (1874)".

Preservation of Traditional of Well-Established Names. Traditional or well-established names that do not follow the above procedures and conventions should not be abandoned providing they are or may become well defined or characterized.

Lithologic component of name.

If a lithologic term is used in the name of a lithostratigraphic unit it should be a simple, generally accepted term that indicates the predominant lithology of the unit. Compound, combined or lithogenetic terms should not be used.

Some special aspects of igneous and metamorphic rocks.

Stratified volcanic rocks and bodies of metamorphic rocks that can be recognized as of sedimentary and/or extrusive volcanic origin can be treated as sedimentary lithostratigraphic units.