# Stratigraphy

COURSE OF STRATIGRAPHY G301
SECOND SEMESTER (FEBRUARY-JUNE, 2014)
DEPARTMENT OF GEOLOGY
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Lecture 2

# The Vertical Dimension

| Stratigraphic categories | Principal stratigraphic unit terms | |
|---|---|---|
| Lithostratigraphic<br>Defines a body of rock strata unified by overall homogeneity of lithology or combination of lithologies; may be sedimentary, metamorphic, or igneous | Group<br>Formation<br>Member<br>Bed(s) | |
| Biostratigraphic<br>Defines a body of rock unified by its fossil content | Biozones<br>Assemblage zones<br>Range zones (various kinds)<br>Acme zones<br>Interval zones<br>Other kinds of biozones | |
| Chronostratigraphic<br>Defines a body of rock unified by being formed all rocks during a specific interval of geologic time; represents formed anywhere during a certain segment of earth history | (Equivalent units)<br>Eonothem<br>Erathem | <br>Eon<br>Era |
| Geochronologic<br>Defines a unit of geologic time determined by geologic methods; may correspond to the time-span of a stratigraphic unit | System<br>Series<br>Stage<br>Chronozone | Period<br>Epoch<br>Age<br>Chron |

# Biostratigraghy

- **Biostratigraphy:** is the classification of bodies of rock or rock material into biostratigraphic units based on their contained fossils.
- Good biostratigraphy requires:
  - Common fossils
  - Good taxonomy
  - Accurate location of these fossils in carefully measured sections. This requires:
    - The vertical changes in fossils can be noted at one place and convenient boundaries chosen.
    - These changes and boundaries must be recognized at other places.

# Facies Fossils vs. Zone Fossils

| Facies Fossils | Zone Fossils |
| --- | --- |
| • The fossil space may correspond with the rock space if the organisms were controlled by the same factors controlling the deposition of the sediment. | • The fossil space may appear completely independent if the rock units; also, different taxa may give different fossil spaces. |

# Kinds of Biostratigraphic Units (Fossil Zones)

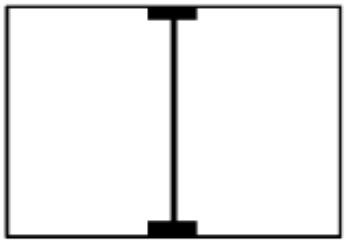
- **Zones:** are based on the vertical ranges of individual species or assemblages of species in section.
- 
- **Biozone:** is the fundamental biostratigraphic unit.
- There are <u>five specific kinds</u> of biozones, these are:
  - 1- Range Biozone
  - 2- Interval Biozone
  - 3- Lineage Biozone
  - 4- Assemblage Biozone
  - 5- Abundance Biozone
- Note// These five kinds of biozones are not hierarchically interrelated.

# Range Zone (*taxon range zone*)

- **Range Biozone:** is a body of rock representing the known stratigraphic and geographic range of occurrence of any selected element or elements of the chosen fossil taxon, or taxa, present in the rock record.
- There are two kinds of range biozones:

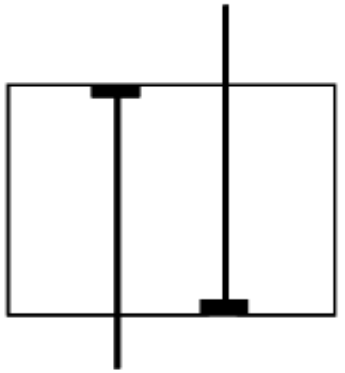
# Types of Range Zones

- **1- A taxon-range biozone:** is a body of rock representing the known stratigraphic and geographic range of a chosen taxon.



A. Taxon-range Biozone (based the range of a taxon).

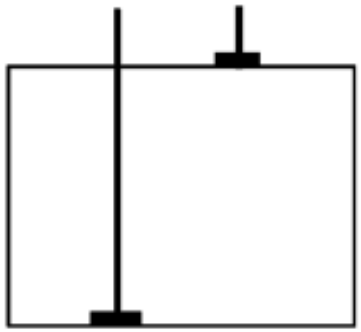
- **2- A concurrent-range biozone:** is a body of rock including the concurrent, coincident, or overlapping part of the ranges of two specified taxa.



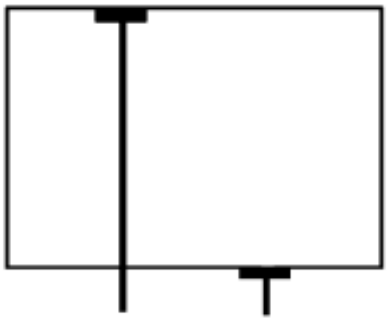
B. Concurrent-range Biozone (based on range of concurrent occurrences of two taxa).

# Interval Zone

- **An interval biozone** is a body of rock between two specified biostratigraphic surfaces (biohorizons). The features on which biohorizons are commonly based include lowest occurrences, highest occurrences, distinctive occurrences, or changes in the character of individual taxa (e.g., changes in the direction of coiling in foraminifera or in number of septa in corals).



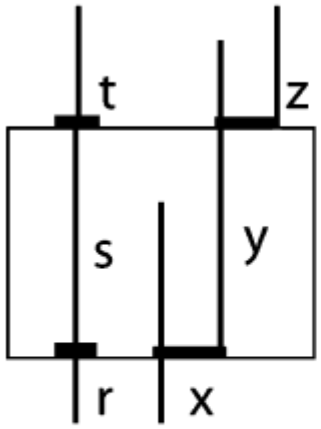
C. Interval Biozone (based on lowest occurrences).



D. Interval Biozone (based on highest occurrences).

# Lineage Biozone

- **A lineage biozone** is a body of rock containing species representing a specific segment of an evolutionary lineage.




E. Lineage Biozone (based on successive elements in a segment of an evolutionary lineage).

EXPLANATION

Lower or upper range of taxon

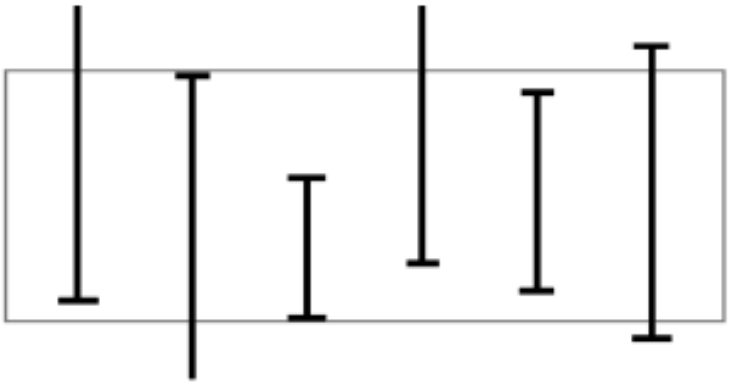
Vertical range of taxon

Lower or upper boundary of biozone

r,s,t,x,y,z Taxa

# Assemblage Biozone

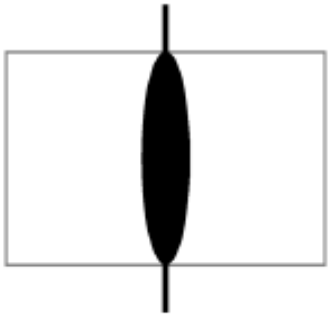
- **An assemblage biozone** is a body of rock characterized by a unique association of three or more taxa, the association of which distinguishes it in biostratigraphic character from adjacent strata. An assemblage biozone may be based on a single taxonomic group, for example, trilobites, or on more than one group, such as acritarchs and chitinozoans.



A. Assemblage Biozone (based on the overlapping ranges of an assemblage of co-occurring taxa).

# Abundance Biozone

- **An abundance biozone** is a body of rock in which the abundance of a particular taxon or specified group of taxa is significantly greater than in adjacent parts of the section.
- *Abundance zones may be of limited, local utility because abundances of taxa in the geologic record are largely controlled by paleoecology, taphonomy, and diagenesis. The only unequivocal way to identify a particular abundance zone is to trace it laterally.*



B. Abundance Biozone (thickened line denotes range of increased abundance of the taxon).

# Boundaries (Biohorizones)

- The boundaries of a biozone are drawn at surfaces that mark the lowest occurrence, highest occurrence, limit, increase in abundance, or decrease in abundance of one or more components of the fauna or flora.
- Note// the base or top of one kind of biozone may not, or need not, coincide with the base or top of another kind of biozone.

# Name of Biozone

- **The name of a biozone** consists of the name of one or more distinctive taxa or parataxa (for trace fossils) found in the biozone, followed by the word "Biozone."
- (e.g., Turborotalia cerrozaulensis Biozone or Cyrtograptus lundgreni-Testograptus testis Biozone).

- The name of the species whose lowest occurrence defines the base of the zone is the most common choice for the biozone name.
- Note// names of the nominate taxa, and hence the names of the biozones, conform to the rules of the international codes of zoological or botanical nomenclature or, in the case of trace fossils, internationally accepted standard practice.

# Good Zone Fossils

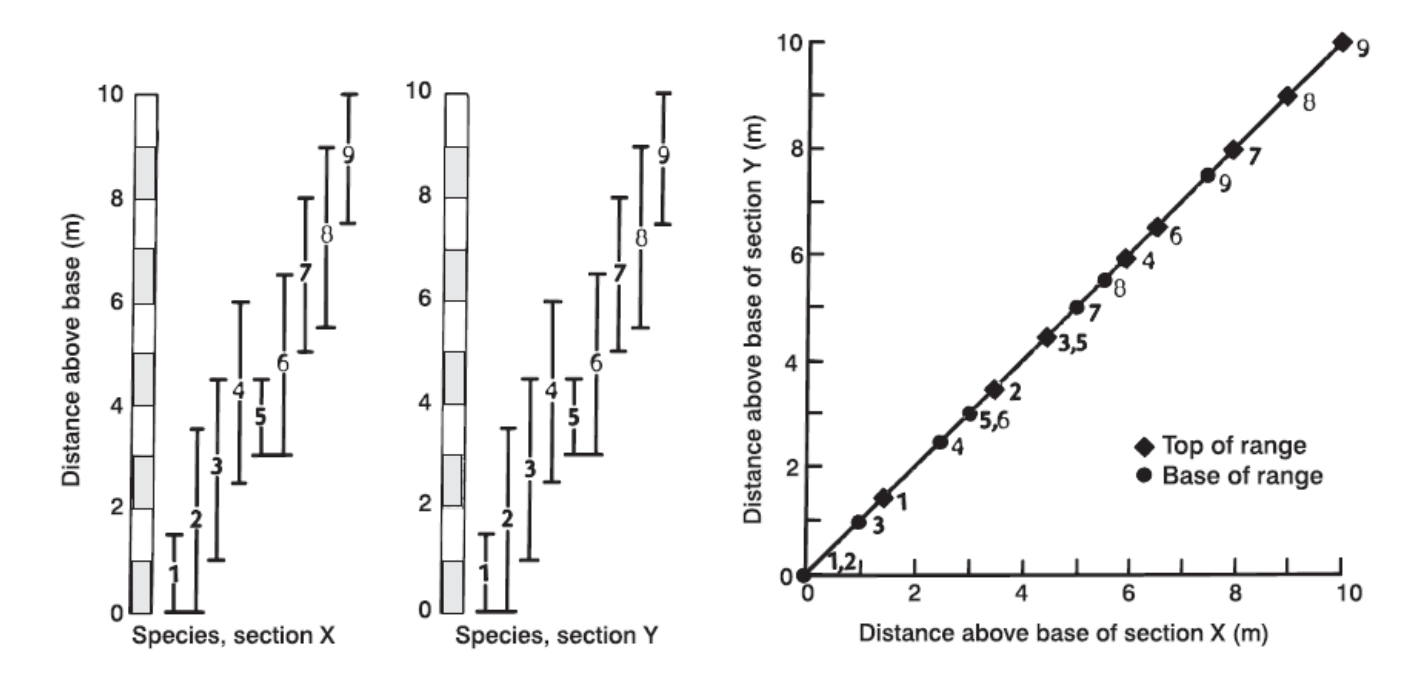
- Any fossil group can be used for zoning. But since the aim is to recognize the smallest time intervals over the widest area, zone fossils should ideally have the following characteristics:
  - 1- A relatively wide paleogeographic range, usually marking wide ecological tolerances.
  - 2- Limited vertical time range of species.
  - 3- Easily recognized changes of taxonomic features on the skeleton.
  - 4- Floating, swimming, or flying forms.
  - 5- Capable to being preserved.
  - 6- Relatively abundant.

# Graphic correlation with fossils

**Alan Shaw's (1964) methods**

➢ **Perfect 45°correlation line:**

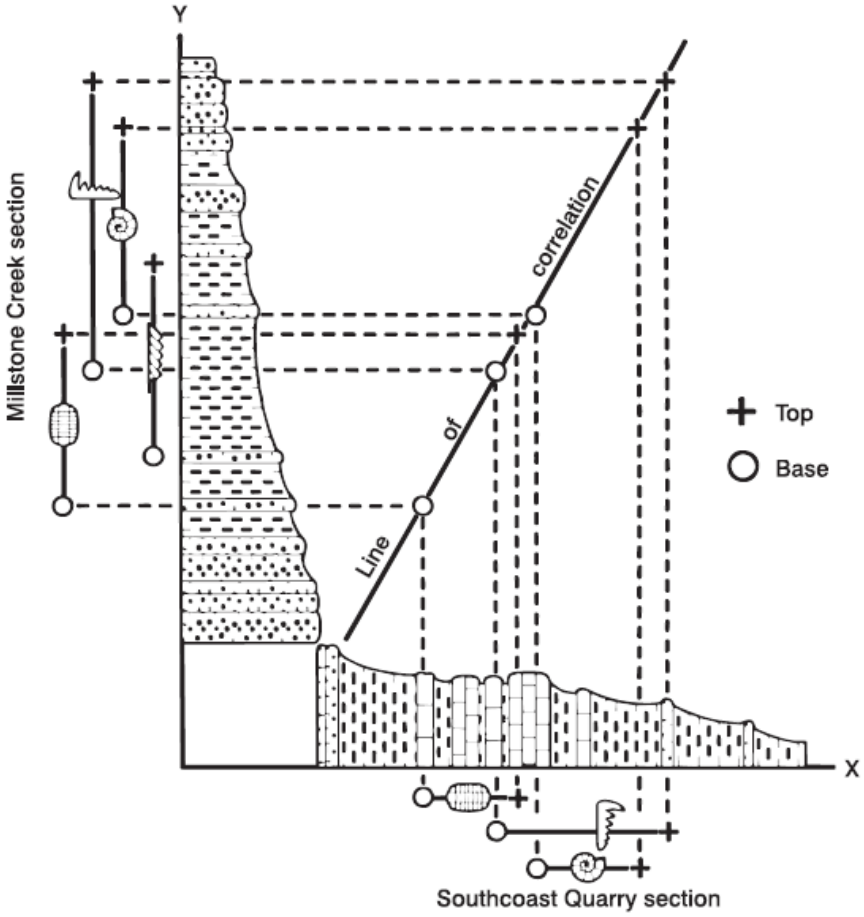
- If the two sections have the same rang of fossil species
- the section must have accumulated at the same rate.




Base and tops of ranges ploton a stright line at 45° correlation in two identical sections (Prothero, 1990 in Brookfiled, 2004)

➢ **Gentler or steeper correlation lines** show that:

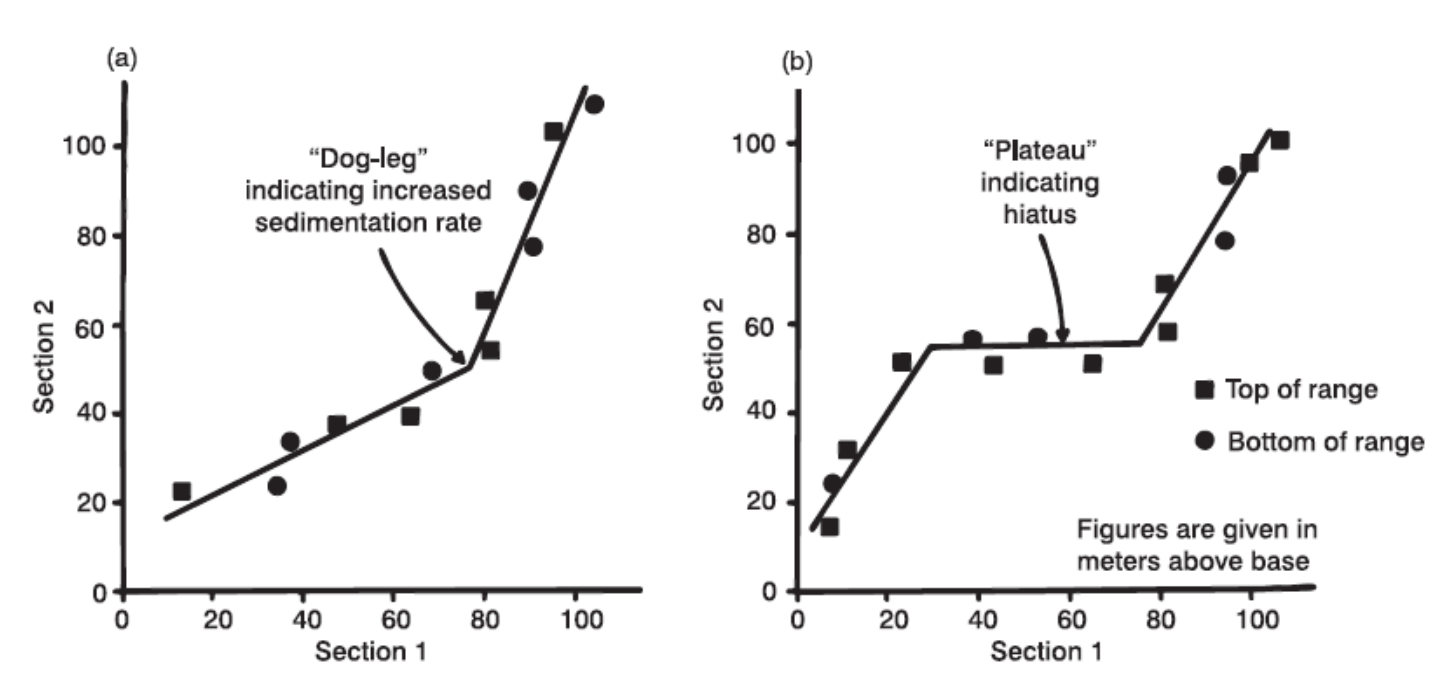
- Constant accumulation rates but different in the two sections.
- allow evaluation if relative rates of sedimentation for the sections.




Range plots for two sections with constant but different sedimentation rates (Pierce, 1995 in Bookfield, 2004).

➢ **Dog- leg: indicates:**

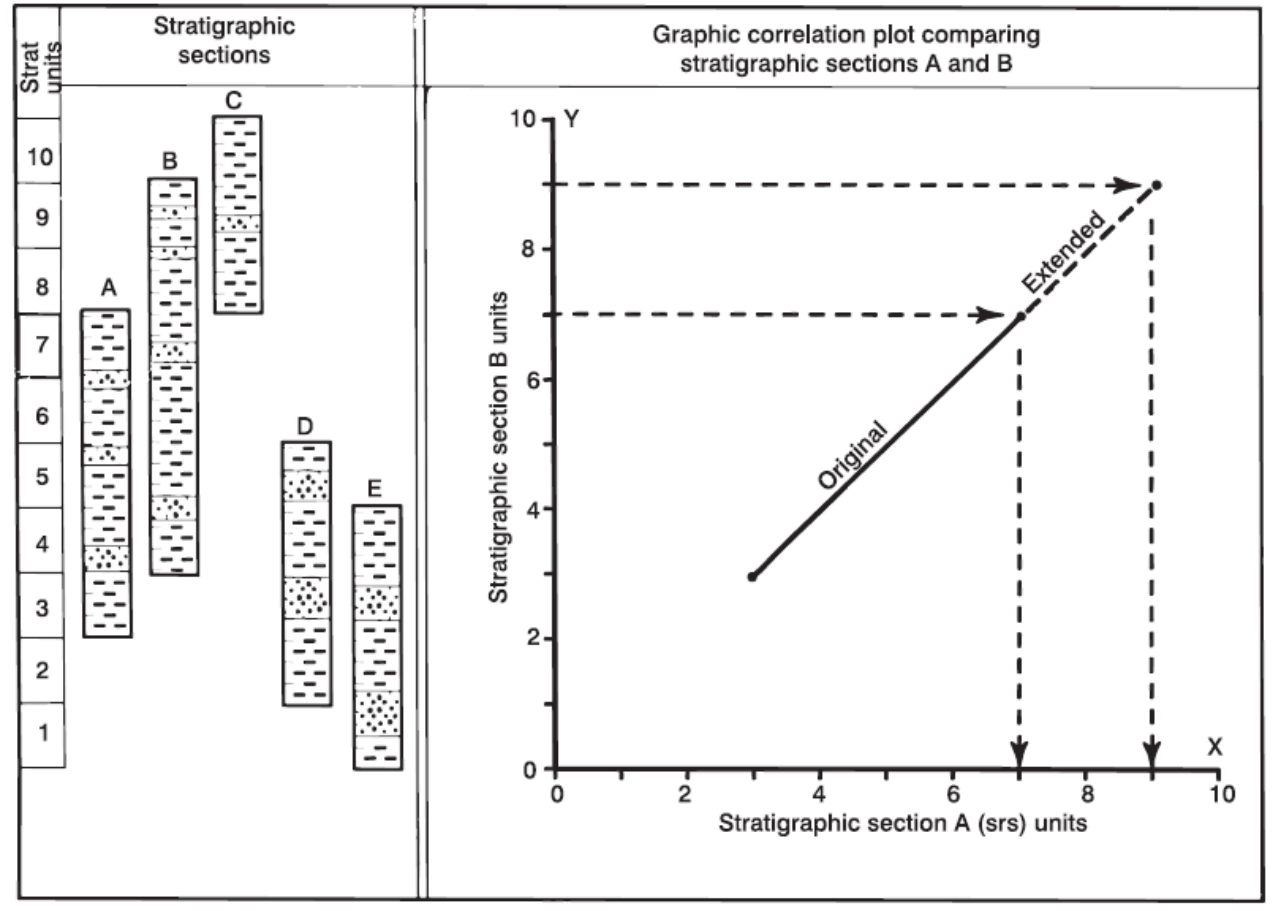
- A change in relative accumulation rates.
- A flat section indicates no accumulation (or erosion) in one section, and a diastem or unconformity.




(a) Change in sedimntation rate and (b) diastem or unconformity in one section (Doyle, 1996 in Brookfield, 2004).

# Composite Standard Section

- A synthesis of many sections.




Composite standard section (Carney and Pierce, 1995 in Brookfield, 2004).

# References


- *This lecture is based on the following references:*

- **Brookfield, M.F.,2004.** Principles of Stratigraphy. Blackwell Publishing, 340P.

- **North American Stratigraphic Code. , 2005.** AAPG Bulletin, v. 89, no. 11, pp. 1547–1591.