

Introduction to Biostratigraphy

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CONTENTS

1. Introduction
2. Nature of Biostratigraphic Units
3. The Fossils
4. Definitions
5. Kinds of Biostratigraphic Units
6. Hierarchy of Biostratigraphic Units
7. Procedures for establishing Biostratigraphic Units
8. Procedures for extending Biostratigraphic Units -
Biostratigraphic Correlation
9. Naming Biostratigraphic Units
10. Revision of Biostratigraphic Units
11. References.

Introduction

- The characterization and correlation of rock units on the basis of their fossil content is called **Biostratigraphy**. It is based on the Principle that organisms have undergone successive changes throughout geologic time. Thus, any unit of strata can be dated and characterized by its fossil content.
- It was the work of an English surveyor and civil engineer named William Smith that we now know that rocks formed during any particular interval of geologic time can be recognized and distinguished by their fossil content from rocks formed during other time interval. This concept has consequently become known as **Principle of Faunal Succession**.

Nature of Biostratigraphic Units

- Biostratigraphic units (biozones) are bodies of strata that are defined or characterized on the basis of their contained fossils.
- Biostratigraphic units exist only where the particular diagnostic feature or attribute on which they are based has been identified. Biostratigraphic units, therefore, are objective units based on the identification of fossil taxa. Their recognition depends on the identification of either their defining or characterizing attributes.
- Biostratigraphic units may be enlarged to include more of the stratigraphic record, both vertically and geographically, when additional data are obtained.
- A biostratigraphic unit may be based on a single taxon, on combinations of taxa, on relative abundances, on specified morphological features, or on variations in any of the many other features related to the content and distribution of fossils in strata. The same interval of strata may be zoned differently depending on the diagnostic criteria or fossil group chosen. Thus, there may be several kinds of biostratigraphic units in the same interval of strata that may have gaps between them or overlaps of their vertical and horizontal ranges.

The Fossils

- 1. Value of fossils :** Fossils were once living organisms and as such are sensitive indicators of past environments, sedimentation patterns, and their distributions. In addition, because of the irreversibility of evolution, fossils are particularly useful in working out the relative times of origin of sedimentary strata.
- 2. Fossil assemblages :** Four kinds of intervals are found in sedimentary rocks : strata without fossils; strata containing organisms that lived and were buried in the area (biocoenosis); strata containing organisms that lived somewhere else and were brought into the area after death (thanatocoenosis); and strata that contain organisms transported alive away from their normal environment. These may be mixed or interbedded in any proportion. All categories of fossil-bearing strata may be the basis for biostratigraphic zonation.
- 3. Reworked fossils :** Fossils from rocks of one age that have been eroded, transported, and redeposited in sediments of a younger age. Because of the difference in their significance with respect to age and environment, they should be treated apart from those believed to be indigenous.
- 4. Introduced or infiltrated fossils :** Fossils introduced into older or younger rocks by fluids, through animal burrows or root cavities, or by sedimentary dikes or diapirs. They should be distinguished from indigenous fossils in biostratigraphic zonation.
- 5. Effects of stratigraphic condensation :** Extremely low rates of sedimentation may result in fossils of different ages and different environments being mingled or very intimately associated in a very thin stratigraphic interval, even in a single bed.

Definitions

1. **Biostratigraphic classification:** The systematic subdivision and organization of the stratigraphic section into named units based on their fossil content.
2. **Biozone :** A general term for any kind of biostratigraphic unit regardless of thickness or geographic extent. Biozones vary greatly in thickness, geographic extent, and represented time span.
3. **Biohorizon :** A stratigraphic boundary, surface, or interface across which there is a significant change in biostratigraphic character. A biohorizon has no thickness and should not be used to describe very thin stratigraphic units that are especially distinctive.
4. **Subzone :** A subdivision of a biozone.
5. **Superzone :** A grouping of two or more biozones with related biostratigraphic attributes.
6. **Zonule :** The use of this term is discouraged. It has received different meanings and is now generally used as a subdivision of a biozone or subbiozone.
7. **Barren intervals :** Stratigraphic intervals with no fossils common in the stratigraphic section.

Kinds of Biostratigraphic Units

Five kinds of Biozones

Range

Interval

Assemblage

Abundance

Lineage

Range Biozone



The body of strata representing the known stratigraphic and geographic range of occurrence of a particular taxon or combination of two taxa of any rank.

a. Taxon-
range
Biozone

b. Concurrent-
range
Biozone

Taxon-range Zone

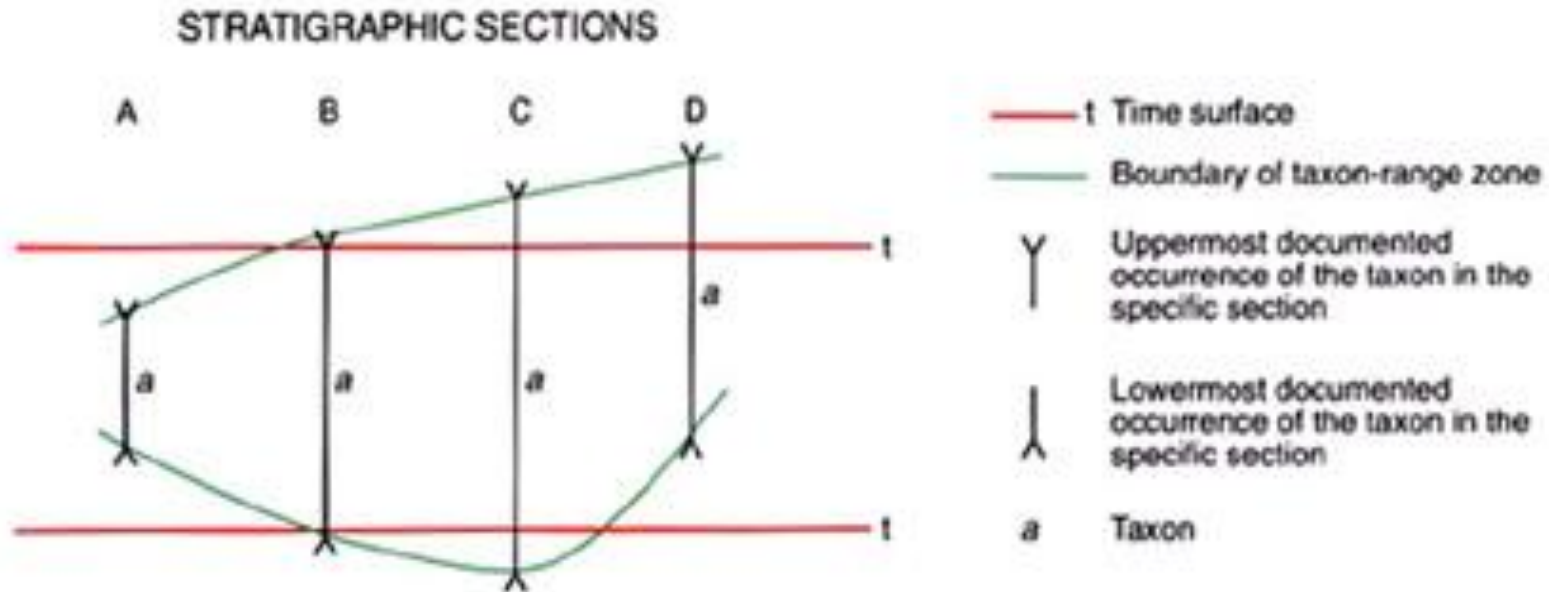


Figure 1: Taxon-range Zone. The lower, upper, and lateral limits of this zone are determined by the range of occurrence of taxon *a*.

- **Definition** : The body of strata representing the known range of stratigraphic and geographic occurrence of specimens of a particular taxon.
- **Boundaries** : The boundaries of a taxon-range zone in any one section are the horizons of lowest stratigraphic occurrence and highest stratigraphic occurrence of the specified taxon in that section.
- **Name** : The taxon-range zone is named from the taxon whose range it expresses.
- **Local range of a taxon** : It may be specified in some local section, area, or region as long as the context is clear.

Concurrent-range Zone

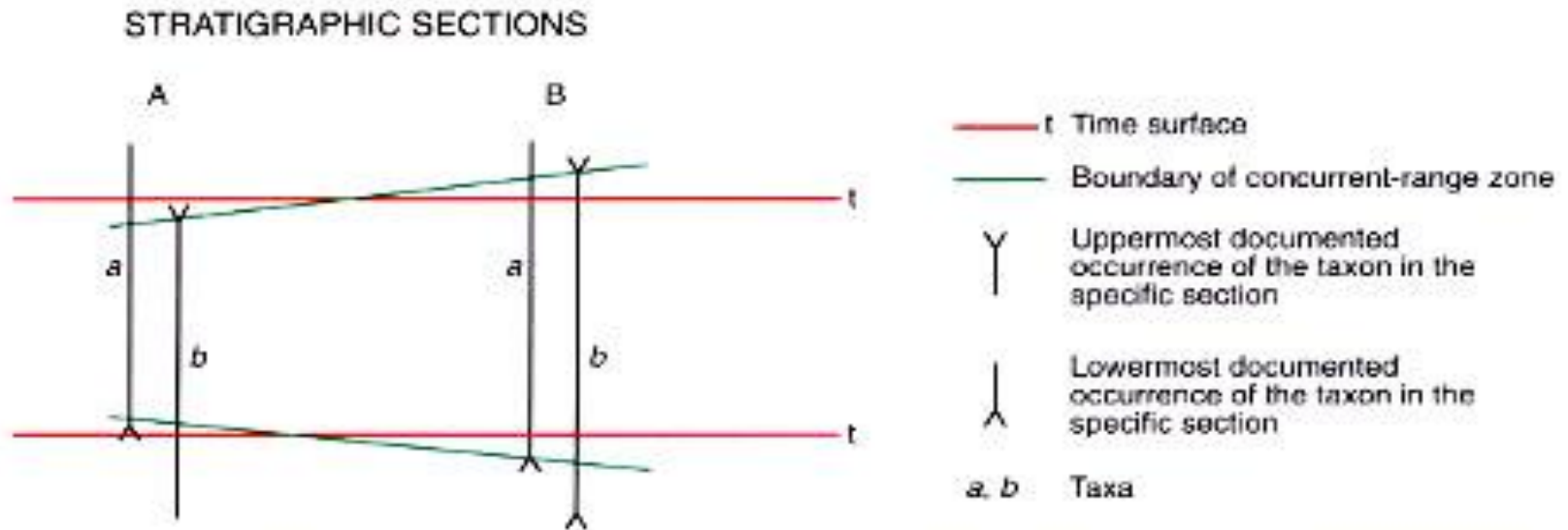


Figure 2: Concurrent-range Zone. The lower, upper, and lateral limits of this zone are determined by the range of concurrent occurrence of taxa *a* and *b*.

- **Definition** : The body of strata including the overlapping parts of the range zones of two specified taxa..
- **Boundaries** : The boundaries of a concurrent-range zone are defined in any particular stratigraphic section by the lowest stratigraphic occurrence of the higher-ranging of the two defining taxa and the highest stratigraphic occurrence of the lower-ranging of the two defining taxa.
- **Name** : A concurrent-range zone is named from both the taxa that define and characterize the biozone by their concurrence.

Interval Zone

STRATIGRAPHIC SECTIONS

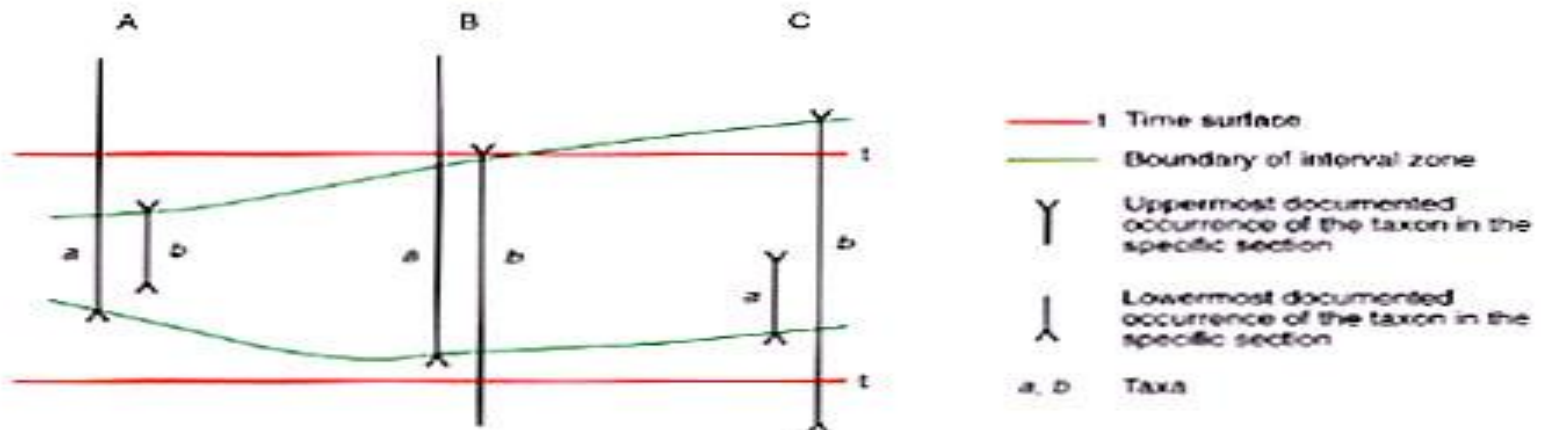


Figure 3: Interval Zone. In this example, the lower limit of the zone is the lowermost known occurrence of taxon *a*, and the upper limit is the highest known occurrence of taxon *b*. The zone extends laterally as far as both of the defining biohorizons can be recognized.

STRATIGRAPHIC SECTIONS

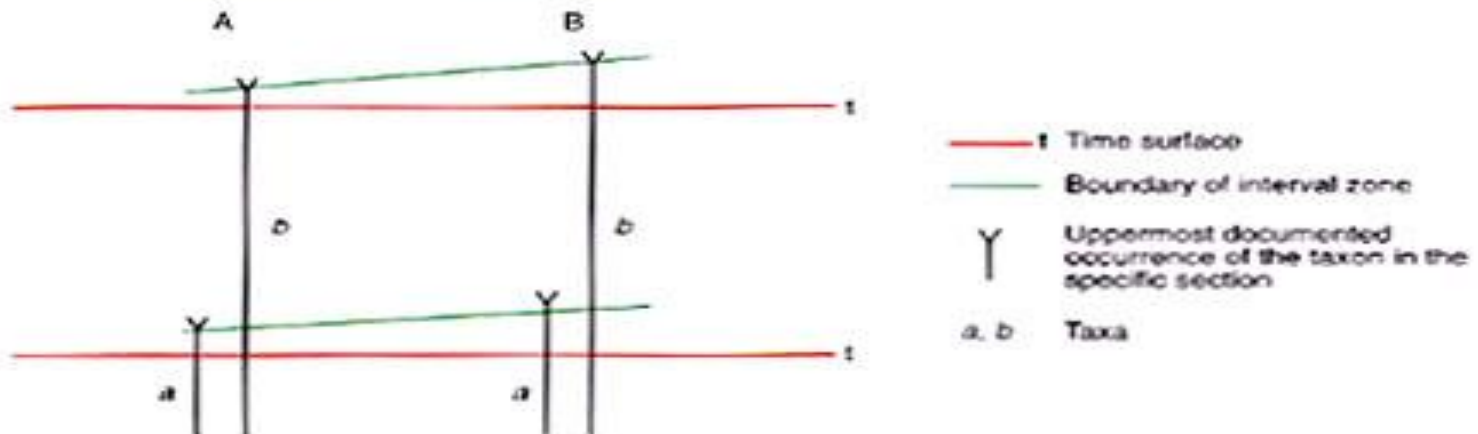


Figure 4: Interval Zone (Highest-occurrence Zone). This kind of interval zone is particularly useful in subsurface work.

Interval Zone

- **Definition** : The body of fossiliferous strata between two specified biohorizons. Such a zone is not itself necessarily the range zone of a taxon or concurrence of taxa; it is defined and identified only on the basis of its bounding biohorizons (Figure 3). In subsurface stratigraphic work, where the section is penetrated from top to bottom and paleontological identification is generally made from drill cuttings, often contaminated by recirculation of previously drilled sediments and material sloughed from the walls of the drill hole, interval zones defined as the stratigraphic section comprised between the highest known occurrence (first occurrence downward) of two specified taxa are particularly useful (Figure 4).

- **Boundaries** : The boundaries of an interval zone are defined by the occurrence of the biohorizons selected for its definition.

- **Name** : The names given to interval zones may be derived from the names of the boundary horizons, the name of the basal boundary preceding that of the upper boundary; e.g. *Globigerinoides sicanus*-*Orbulina suturalis* Interval Zone.

Lineage Zone

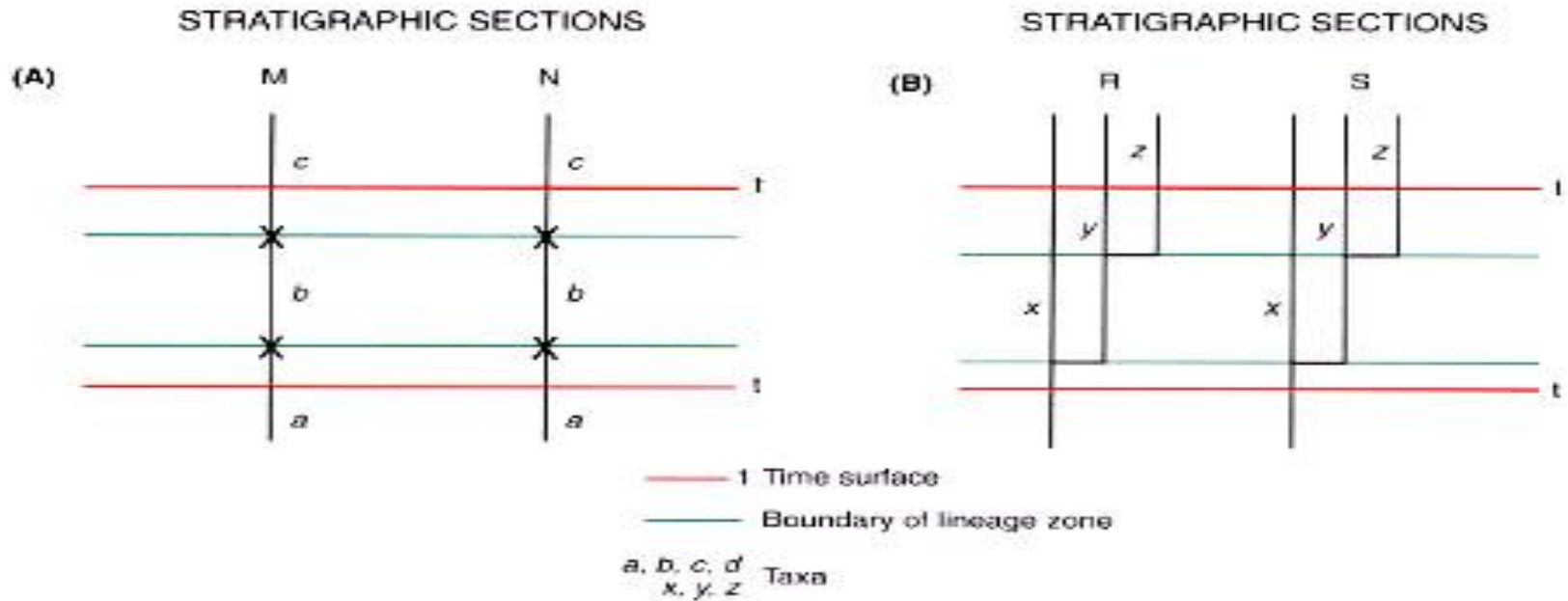


Figure 5: Examples of lineage zones. In A the lineage zone represents the entire range of taxon *b*, from the highest occurrence of its ancestor, taxon *a*, to the lowermost occurrence of its descendant, taxon *c*. In B the lineage zone represents that part of the range of taxon *y* between its lowest occurrence and the lowest occurrence of its descendant, taxon *z*.

- **Definition** : The body of strata containing specimens representing a specific segment of an evolutionary lineage.
- **Boundaries** : The boundaries of a lineage zone are determined by the biohorizons representing the lowest occurrence of successive elements of the evolutionary lineage under consideration.
- **Name** : A lineage zone is named for the taxon in the lineage whose range or partial range it represents.

Assemblage Zone

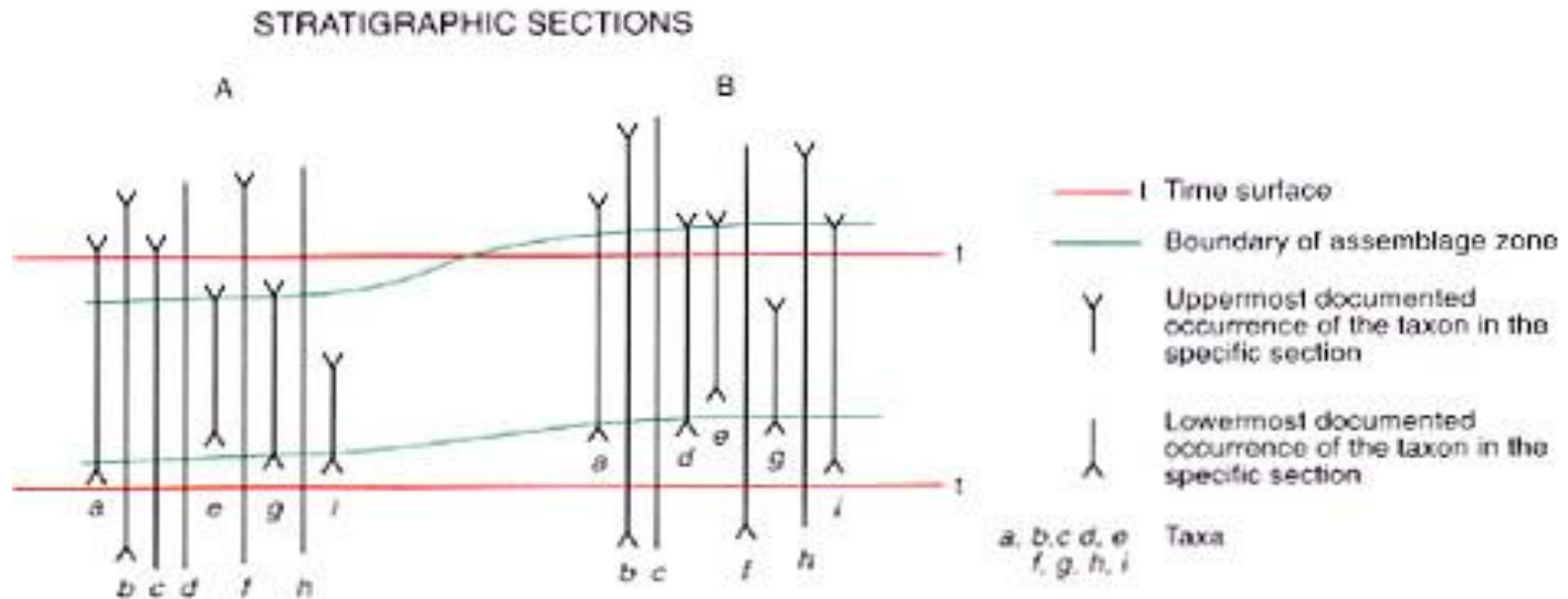


Figure 6: Assemblage Zone. In this example, the assemblage diagnostic of the zone includes nine taxa with diverse stratigraphic ranges. For this assemblage zone to be useful, it may be necessary to provide some explicit description of its boundaries: for example, the lower boundary can be said to be placed at the lowermost occurrence of taxa *a* and *g* and the upper boundary at the highest occurrence of taxon *e*. Most of the taxa of the assemblage characteristic of the zone should, however, be present.

- **Definition** : The body of strata characterized by an assemblage of three or more fossil taxa that, taken together, distinguishes it in biostratigraphic character from adjacent strata.
- **Boundaries** : The boundaries of an assemblage zone are drawn at biohorizons marking the limits of occurrence of the specified assemblage that is characteristic of the unit.
- **Name** : The name of an assemblage zone is derived from the name of one of the prominent and diagnostic constituents of the fossil assemblage..

Abundance zone

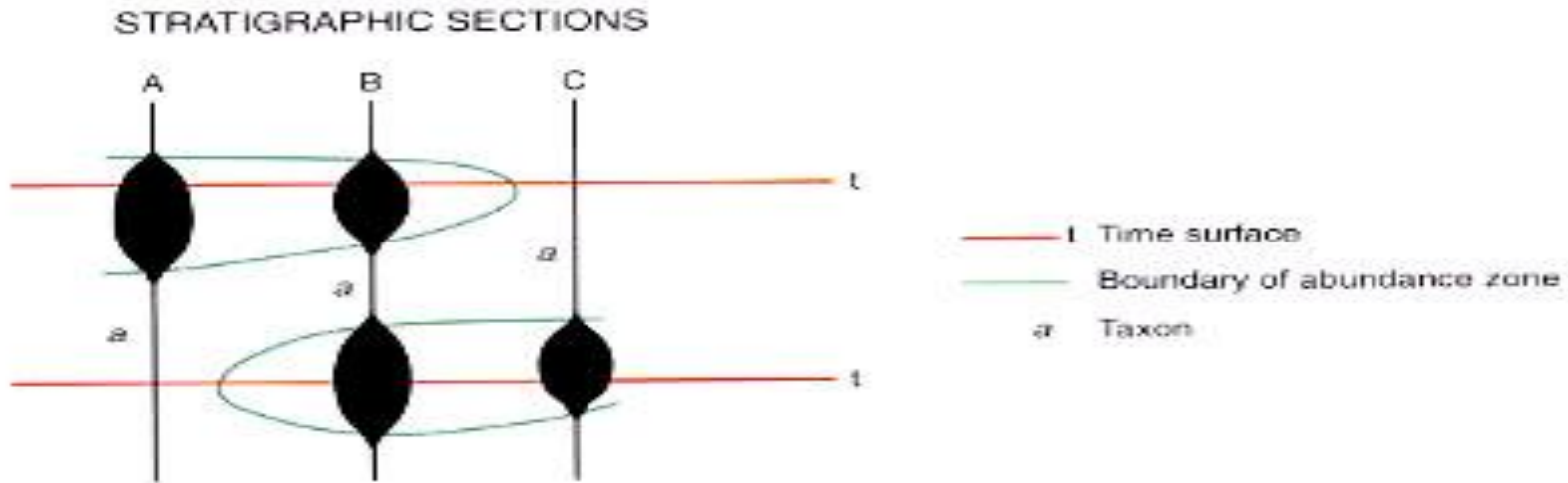


Figure 7: Abundance zones.

- **Definition** : The body of strata in which the abundance of a particular taxon or specified group of taxa is significantly greater than is usual in the adjacent parts of the section.
- **Boundaries** : The boundaries of an abundance zone are defined by the biohorizons across which there is notable change in the abundance of the specified taxon or taxa that characterize the zone.
- **Name** : The abundance zone takes its name from the taxon or taxa whose significantly greater abundance it represents.

Hierarchy of Biostratigraphic Units

- The different kinds of biostratigraphic units described above do not represent different ranks of a biostratigraphic hierarchy, except in the case of subzones and superzones, where the prefix indicates the position in a hierarchy.
- With respect to taxon-range zones, there is no need for a hierarchy of biozone terms because the hierarchical system of biological taxonomy extends also to these biostratigraphic units in the sense that the range zone of a species is subsidiary to the range zone of the genus to which it belongs, and so on.

Procedures for establishing Biostratigraphic Units

- It is recommended that the definition or characterization of a biostratigraphic unit include the designation of one or more specific reference sections that demonstrate the stratigraphic context of the taxon or taxa diagnostic of the unit.

Procedures for extending Biostratigraphic Units - Biostratigraphic Correlation

- Biostratigraphic units are extended away from the areas where they were defined or from their reference sections by biostratigraphic correlation, which is the establishment of correspondence in biostratigraphic character and position between geographically separated sections or outcrops based on their fossil content.
- Biostratigraphic correlation is not necessarily time-correlation. It may approximate time correlation, or it may be the identification of the same biofacies, which may be diachronous.

Naming Biostratigraphic Units

- The formal name of a biostratigraphic unit should be formed from the names of one, or no more than two, appropriate fossils combined with the appropriate term for the kind of unit in question. The function of a name is to provide a unique designation for the biozone. Thus, any taxon in the characteristic assemblage of a biozone may serve as name-bearer so long as it is not already employed.

Revision of Biostratigraphic Units

- Revision of biostratigraphic units honors priority for the sake of stability and precision in communication. However, the first biostratigraphic zonation to be described is not necessarily the most useful. Revision or new biozonations should be clearly defined and/or characterized, be more widely applicable, offer greater precision, and be more easily identified.
- Changes in nomenclature of biostratigraphic units conform with changes in the names of taxa as required by the International Codes of Zoological and Botanical Nomenclature.
- Named biostratigraphic units will automatically change scope to accord with changes in the scope of taxa defining or characterizing them.
- A fossil name once used for a biozone is not available for use in a different zonal sense by a later author. If it is desirable to continue the use of a taxonomic term that is no longer valid, the term should be placed in quotation marks.

References

[1. http://www.stratigraphy.org/upload/bak/bio.htm](http://www.stratigraphy.org/upload/bak/bio.htm)

[2.. Boggs Jr. ,Sam\(2006\). Principles of Sedimentology and Stratigraphy, Fourth Edition, Pearson Prentice Hall](#)

THANKS

