University Of Basrah

College of Science

Department of Geology

STRATIGRAPHY

Lectures Notes for Third-Class Undergraduate Students

Instructed by

Dr. Nawrast Sabah Abdalwahab

Academic Year 2022-2023

Contents

Chapter Two

Categories and ranks of stratigraphic units

Lithostratigraphy

- In lithostratigraphy, rock units are considered in terms of the lithological characteristic of the strata and their relative stratigraphic positions.
- The relative stratigraphic positions of rock units can be determined by considering geometric and physical relationships that indicate which beds are older and which are younger.
- *The main purpose of the stratigraphic division is to make it easier to understand the strata.*
- Lithological subdivisions are usually made on characteristics observable in the field, such as:
- - rock type
- - fossil content
- - color… etc.

Nature of Lithostratigraphic Units

- A lithostratigraphic unit is a defined body of sedimentary, extrusive igneous, metasedimentary, or metavolcanic strata distinguished and delimited based on lithic characteristics and stratigraphic position.
- A lithostratigraphic unit generally conforms to the law of superposition and is commonly stratified and tabular in form.

Ranks of Lithostratigraphic Units

- *The basic lithostratigraphic unit of the subdivision is the FORMATION.*
- **Formation:** a homogeneous rock unit, or an association of distinct interbedded rock units, which are separated from the rock units above and below, and which can be shown on a geological map of at least 1:50 000 scales.
- **Contacts:** are the formation boundaries and usually are placed were marked changes in rock types occur or at an arbitrary marker bed in a gradational succession.
- ***Formations are named after TYPE SECTION.***
- **Type Section:** is the locality where the formation is particularly well exposed, and its character is best seen.

Categories and ranks of stratigraphic units

I. MATERIAL CATEGORIES BASED ON CONTENT OR PHYSICAL LIMITS

LITHOSTRATIGRAPHIC	LITHODEMIC	MAGNETOPOLARITY	BIOSTRATIGRAPHIC	PEDOSTRATIGRAPHIC	ALLOSTRATIGRAPHIC
Supergroup	Supersuite (Complex)				
Group	Suite (Complex)	Polarity Superzone			Allogroup
Formation	*Lithodeme*	*Polarity Zone*	*Biozone* (Interval, Assemblage or Abundance)	*Geosol*	*Alloformation*
Member (or Lens, or Tongue)		Polarity Subzone	Subbiozone		Allomember
Bed(s) or Flow(s)					

IIA. MATERIAL CATEGORIES USED TO DEFINE TEMPORAL SPANS

CHRONO-STRATIGRAPHIC	POLARITY CHRONO-STRATIGRAPHIC
Eonothem	Polarity Superchronozone
Erathem (Supersystem)	
System (Subsystem)	*Polarity Chronozone*
Series	
Stage (Substage)	Polarity Subchronozone
Chronozone	

IIB. NON-MATERIAL CATEGORIES RELATED TO GEOLOGIC AGE

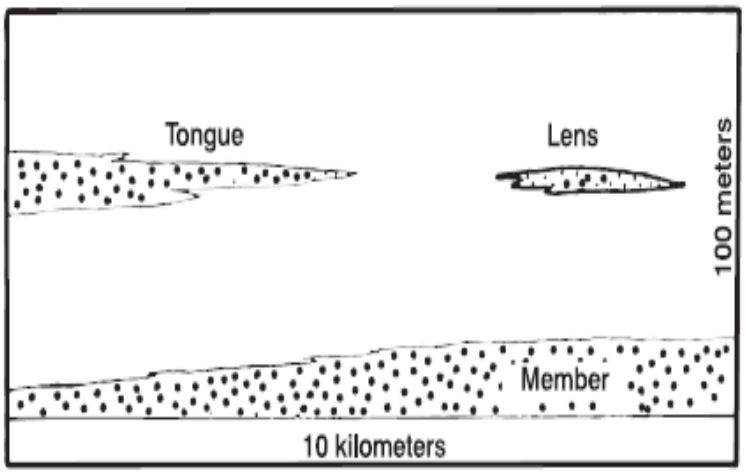
GEOCHRONOLOGIC	POLARITY CHRONOLOGIC	DIACHRONIC	GEOCHRONOMETRIC
Eon	Polarity Superchron		Eon
Era (Superperiod)			Era (Superperiod)
Period (Subperiod)	*Polarity Chron*	*Episode* (Diachron)	*Period* (Subperiod)
Epoch		Phase (Diachron)	Epoch
Age (Subage)	Polarity Subchron	Span (Diachron)	Age (Subage)
Chron		Cline (Diachron)	Chron

*Fundamental units are italicized.

- *Example:*

  - *The type section of* Nahr Umr Formation (Cretaceous) is Nahr Umr-2 well. The formation occurs between drilled depths 2,648.8-2,841.8 m). It is 193 meters thick and is named after the well.

- **Group:** larger rock complexes, which assembled many formations.
- **Member**: a laterally persistent rock unit within a formation.
- **Tongue:** a rock unit that dies out laterally in one direction.
- **Lens**: a rock unit that dies out in both directions.
- **Flow:** is the smallest formal lithostratigraphic unit of volcanic flow rocks.



MEMBER, TONGUE, AND LENS OF SANDSTONE IN A MIXED SANDSTONE-SHALE FORMATION (BROOKFIELD, 2004)

Boundaries (0r the Contacts)

- ❖ Boundaries of lithostratigraphic units are placed at positions of lithic change.
- ❖ Boundaries are placed at distinct contacts or may be selected at arbitrary levels within gradation zones.
- ❖ Both vertical and lateral boundaries are based on the lithic criteria that provide the most remarkable unity and utility.

Breaks in the record

- Unconformities or Diastems, mark pauses in sedimentation or local erosion. Both are caused by the relative change in the base level of decay.
- Unconformities involve relatively uplift and erosion followed by renewed deposition, often under different environmental conditions.

Example

Kirkuk Group (Oligocene)

➢ **Lower Sequence:**

1- Basinal (Palani and Tarjil formations).

2- Reef-forereef (Sheikh Alas Formation).

3- Reef (Shurua Formation).

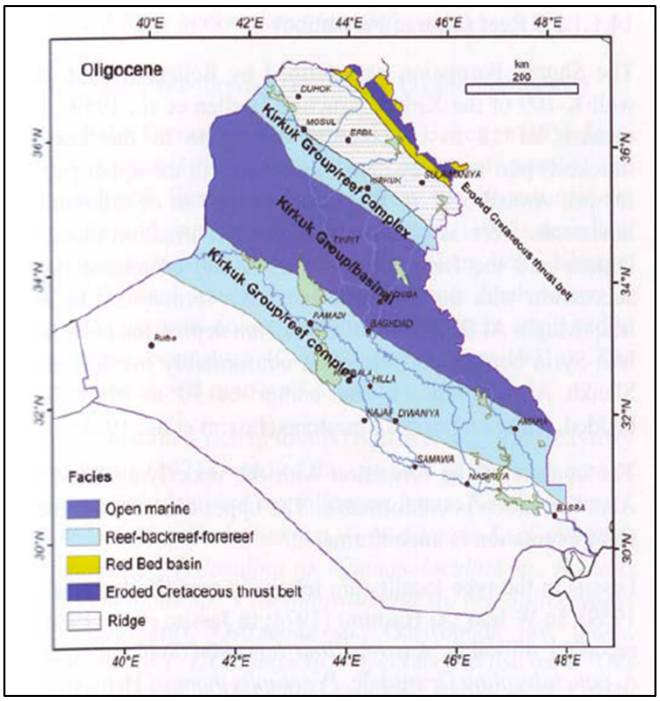
➢ **Upper Sequence:**

1- Basinal (Ibrahim Formation).

2- Reef-forereef (Baba and Azkand formations).

3- Reef-backreef (Bajawan Formation).

4- Reef (Anah Formation).



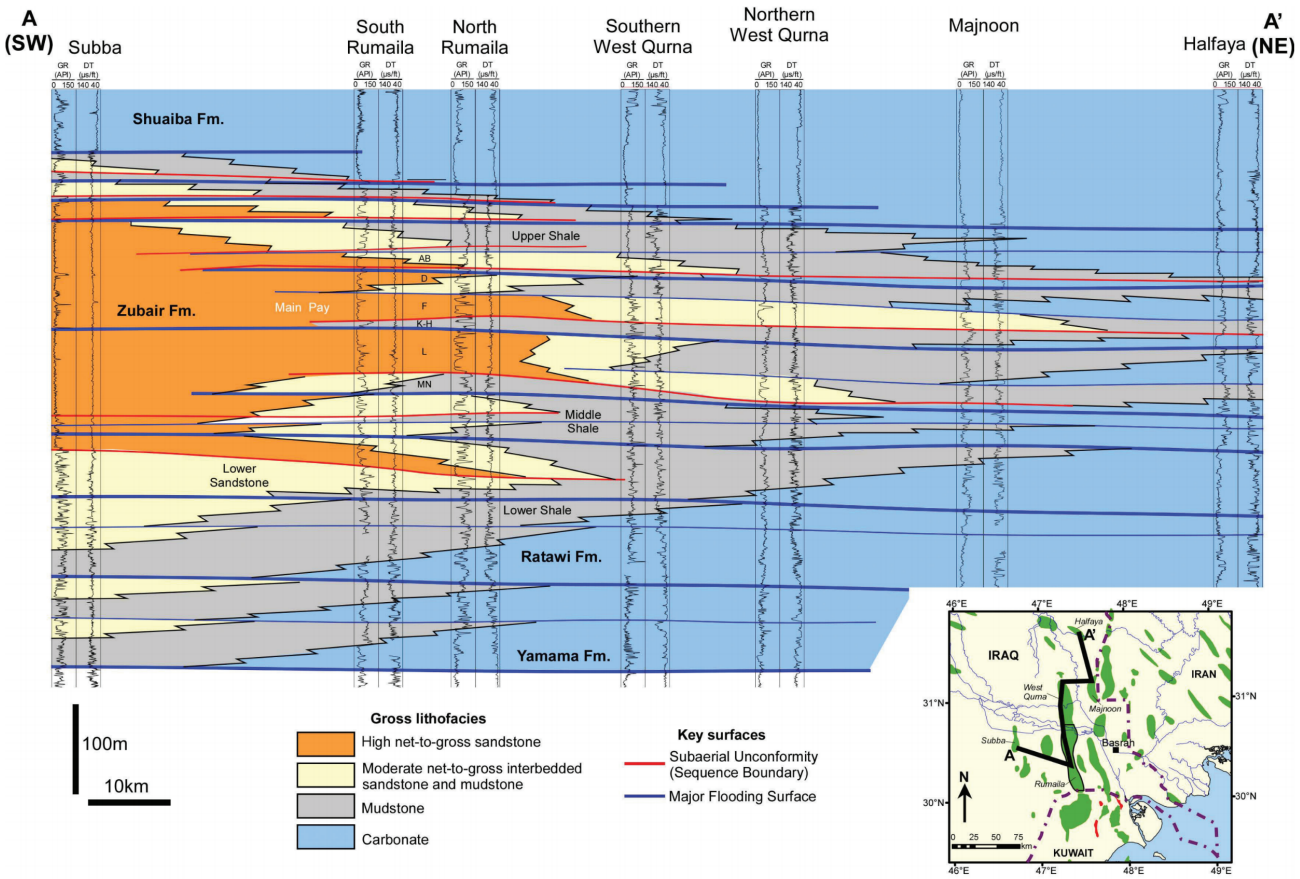
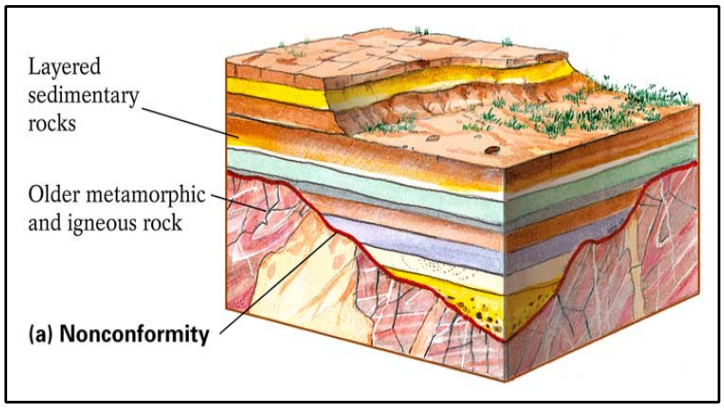


Figure 4. Subregional cross section through the Ratawi, Zubair, and Shuaiba formations illustrating the southwest-to-northeast pinch-out of successive Zubair sandstone tongues and the overall regressive–transgressive nature of the Zubair Formation. Key surfaces are tentatively correlated in the authors' absence of biostratigraphic data outside of Rumaila.

Types of Unconformity

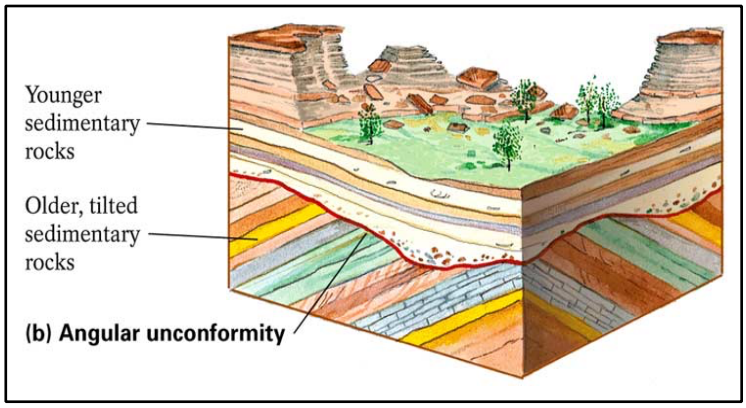
1- Nonconformity

Nonconformity: has a sedimentary rock on an igneous and metamorphic basement.



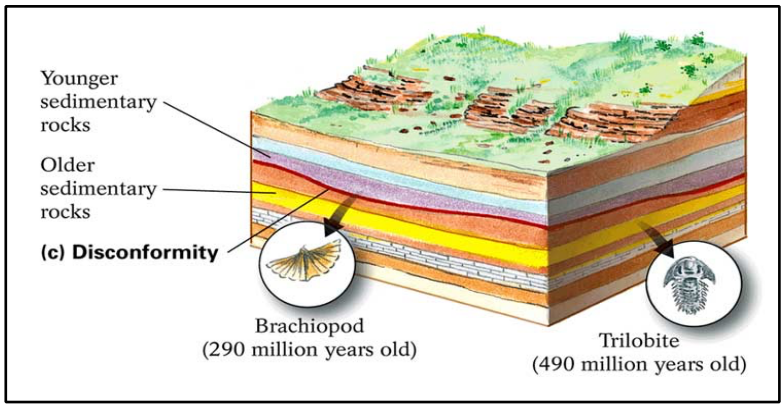
2- Angular Unconformity

Angular unconformity: has a sedimentary rock on tilted, truncated, layered rocks.

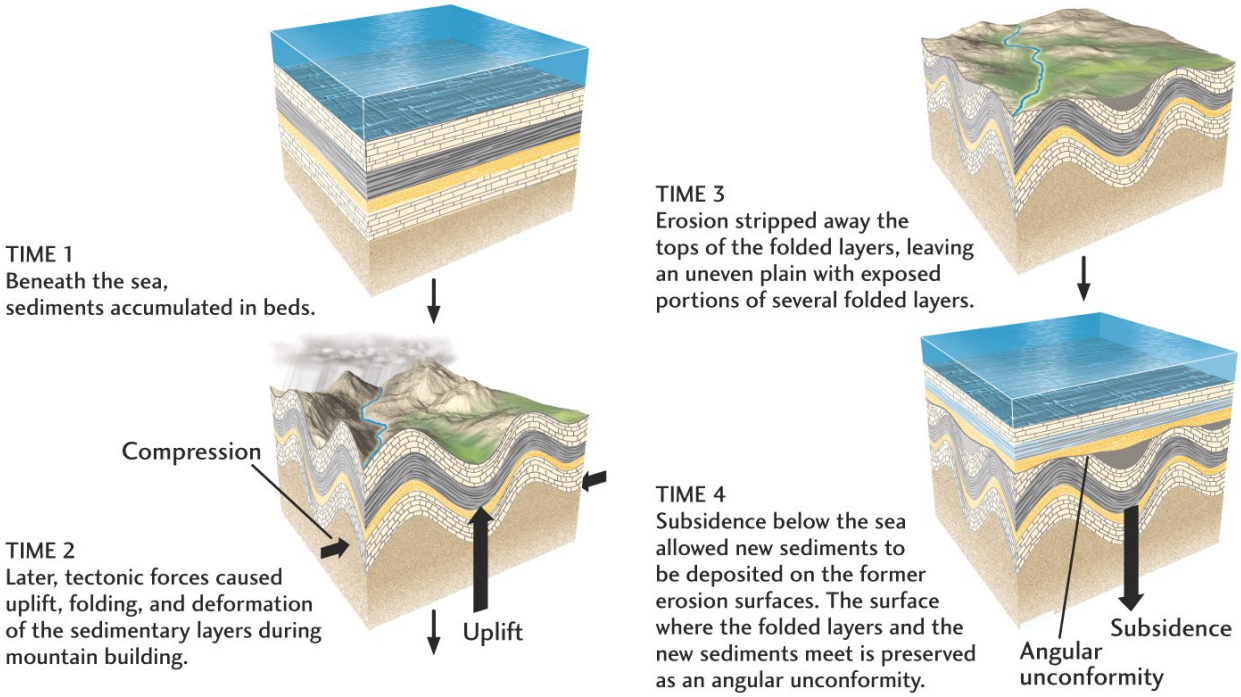


3- Disconformity

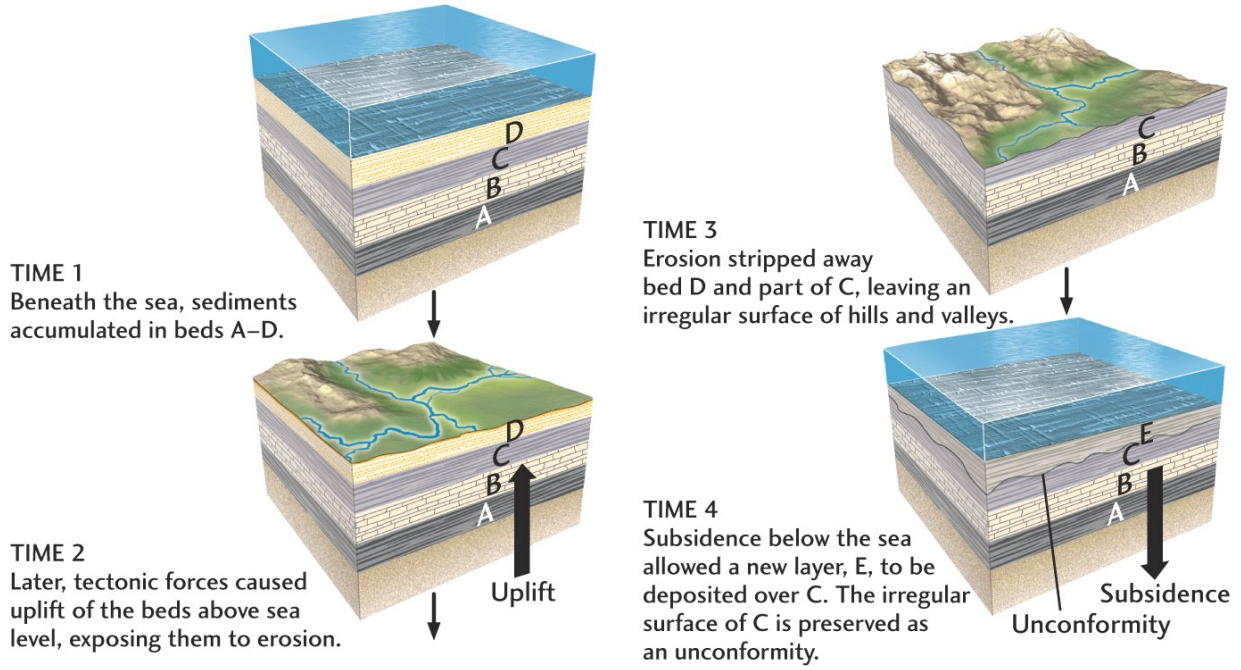
Disconformity: has a sedimentary rock on a rolling eroded surface.



Formation of Angular Unconformity



Formation of disconformity



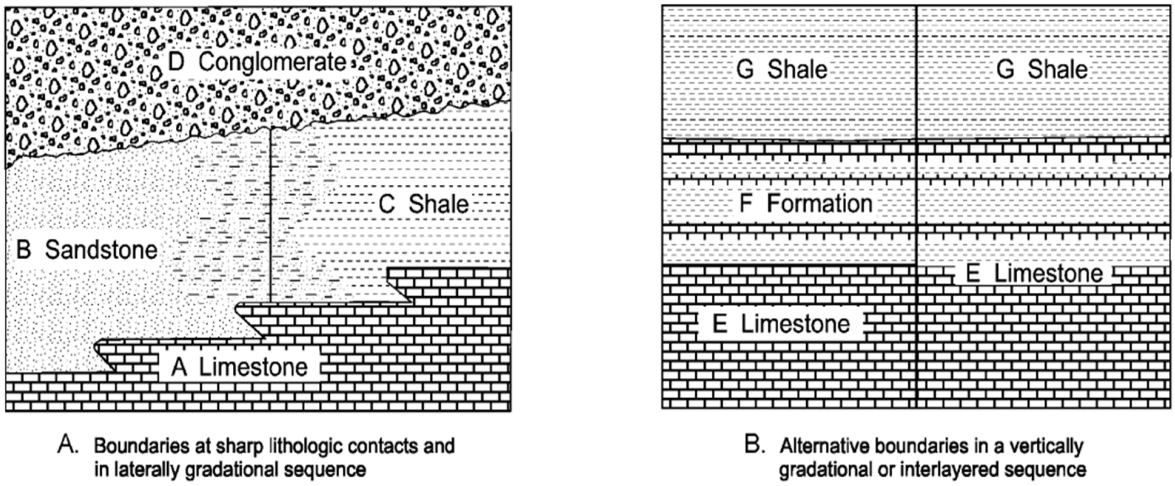
DIASTEMS

Diastems are supposedly more minor time breaks due to variations in the normal processes in an environment, and these are of several scales and types.

Example: flooded river, shifts of delta lenses.

Non-depositional and erosional diastems are caused by changes in the Base level of erosion or aggradation due to environmental fluctuations.

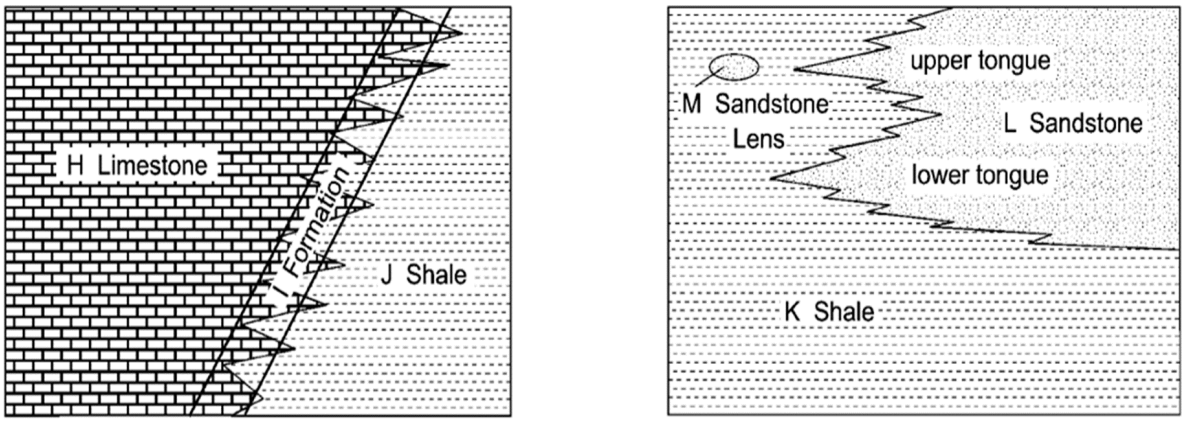
BOUNDARIES



A. Boundaries at sharp lithologic contacts and in laterally gradational sequence

B. Alternative boundaries in a vertically gradational or interlayered sequence

DIAGRAMMATIC EXAMPLES OF LITHOSTRATIGRAPHIC BOUNDARIES AND CLASSIFICATION. AAPG BULLETIN, V. 89, NO. 11 (NOVEMBER 2005), PP. 1547–1591.



C. Possible boundaries for a laterally intertonguing sequence

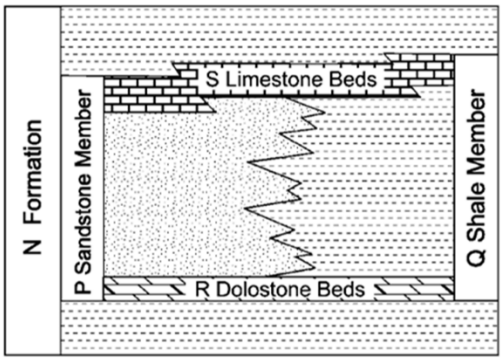
D. Possible classification of parts of an intertonguing sequence

DIAGRAMMATIC EXAMPLES OF LITHOSTRATIGRAPHIC BOUNDARIES AND CLASSIFICATION. AAPG BULLETIN, V. 89, NO. 11 (NOVEMBER 2005), PP. 1547–1591.

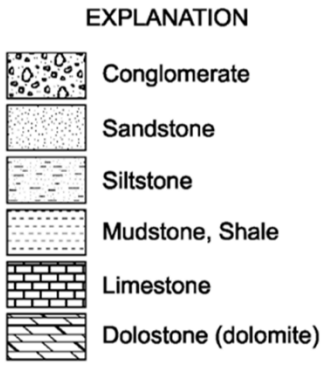
Key Beds

- A key or marker bed is a thin bed of distinctive rock widely distributed. Such beds may be named but usually are considered informal units.
- Key beds may be used as boundaries for a formal lithostratigraphic unit where the internal lithic characteristics of the unit remain relatively constant.
- *Note/ key beds may be very informative and valuable, especially in subsurface work where the key beds may be recognised by their geophysical signatures.*

Key beds used for boundaries



E. Key beds, here designated the R Dolostone Beds and the S Limestone Beds, are used as boundaries to distinguish the Q Shale Member from the other parts of the N Formation. A lateral change in composition between the key beds requires that another name, P Sandstone Member, be applied. The key beds are part of each member



DIAGRAMMATIC EXAMPLES OF LITHOSTRATIGRAPHIC BOUNDARIES AND CLASSIFICATION. AAPG BULLETIN, V. 89, NO. 11 (NOVEMBER 2005), PP. 1547–1591.

LITHODEMIC UNITS

- **Nature and Boundaries**

- A lithodemic unit is a defined body of predominantly intrusive, highly deformed, and/or highly metamorphosed rock, distinguished and delimited based on rock characteristics.
- In contrast to lithostratigraphic units, a lithodemic unit generally does not conform to the Law of Superposition. Its contact with other rock units may be sedimentary, extrusive, tectonic, or metamorphic.

- **Recognition and definition**

- Lithodemic units are defined and recognised by observable rock characteristics. They are the functional units of general geological work in terranes in which rock bodies generally lack primary stratification; in such terranes, they serve as the foundation for studying, describing and delineating lithology, local and regional structure, economic resources, and geologic history.

- **Boundaries**

- Boundaries of lithodemic units are placed at positions of lithic change. They may be placed at clearly distinguished contacts or within zones of gradation. Boundaries, both vertical and lateral, are based on the lithic criteria that provide the most remarkable unity and practical utility.

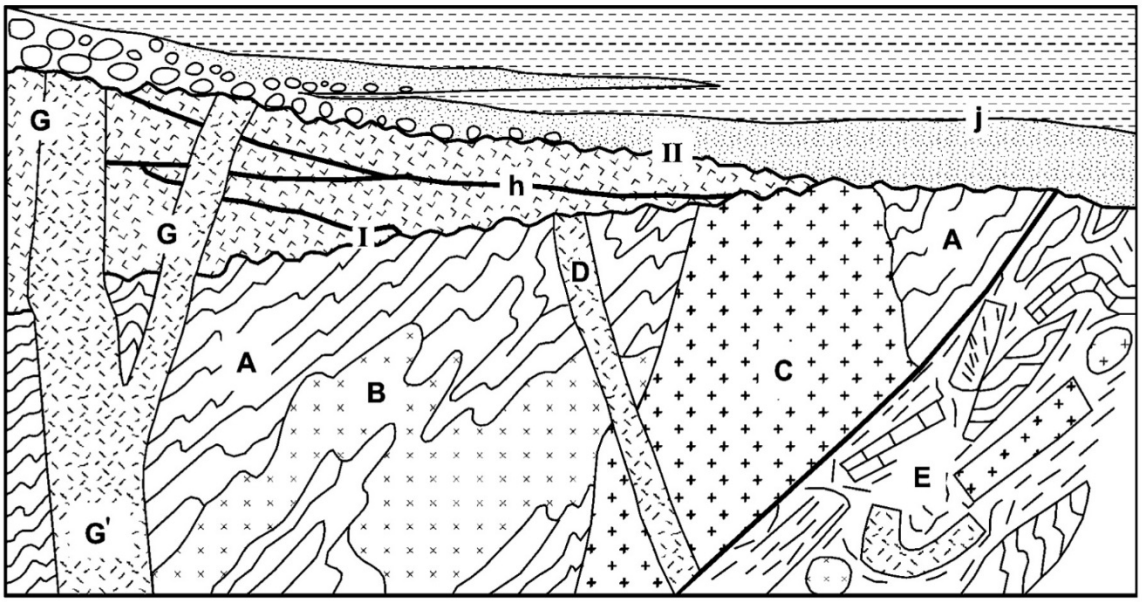


Figure 3. Lithodemic (upper case) and lithostratigraphic (lower case) units. A *lithodeme* of *gneiss* (A) contains an *intrusion* of diorite (B) that was deformed with the gneiss. A and B may be treated jointly as a *complex*. A younger *granite* (C) is cut by a *dike* of *syenite* (D) that is cut in turn by unconformity I. All the foregoing are in fault contact with a *structural complex* (E). A *volcanic complex* (G) is built upon unconformity I, and its feeder dikes cut the unconformity. Laterally equivalent volcanic strata in orderly, mappable succession (h) are treated as lithostratigraphic units. A *gabbro* feeder (G′), to the volcanic complex, where surrounded by gneiss is readily distinguished as a separate lithodeme and named as a *gabbro* or an *intrusion*. All the foregoing are overlain, at unconformity II, by sedimentary rocks (j) divided into formations and members.

Contacts with other lithodemic and lithostratigraphic units may be depositional, intrusive, metamorphic, or tectonic.

Ranks of Lithodemic Units

- Lithodeme. The lithodeme is the fundamental unit in lithodemic classification. A lithodeme is a body of intrusive, pervasively deformed, or highly metamorphosed rock, generally non-tabular and lacking primary depositional structures, and characterised by lithic homogeneity. It is mappable at the Earth's surface and traceable in the subsurface.

- Suite. A suite (metamorphic, intrusive, and plutonic suite) is the lithodemic unit next higher in rank to lithodeme. It comprises two or more associated lithodemes of the same class (e.g., plutonic, metamorphic).
- Supersuite. A supersuite is the unit next higher in rank to a suite. It comprises two or more suites or complexes with a degree of natural relationship, either in the vertical or the lateral sense.
- Complex. An assemblage or mixture of rocks of two or more genetic classes, i.e., igneous, sedimentary, or metamorphic, may be named a complex, with or without a highly complicated structure.

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.
- **Wells, M., A. Bowman, B. Kostic, N. Campion, D. Finucane, C. Santos, D. Kitching, and R. Brown, 2019,** Early Cretaceous deltaic deposits of the Main Pay Reservoir, Zubair Formation, southeast Iraq: Depositional controls on reservoir performance, in H. R. AlAnzi, R. A. Rahmani, R. J. Steel and O. M. Soliman, eds., Siliciclastic reservoirs of the Arabian plate: AAPG Memoir 116, p. 219–260.