Bedding Uncomformities

Bedding or stratification

- Stratigraphy studies bedded rocks
- Sedimentary, metasedimentary metamorphic rocks and volcanoclastic rocks
- The Bed is the basic unit of bedding
- Each Bed a homogenous body differentiating from the others in terms of composition, texture (size, shape, sorting, arrangement of grains), colour, hardness, diagenesis, structure
- **Stratification** (= layering or **bedding**) is the most obvious feature of sedimentary rocks. The layers (or beds or strata) are visible because of differences in the color, texture, or composition of adjacent beds.

Bed (stratum)

- Confined between two contacts, bedding planes, bed floor and bed roof
- Contacts sharp or gradual
- Based on their thickness strata separated into Beds (>1cm) and Laminae (<1cm)

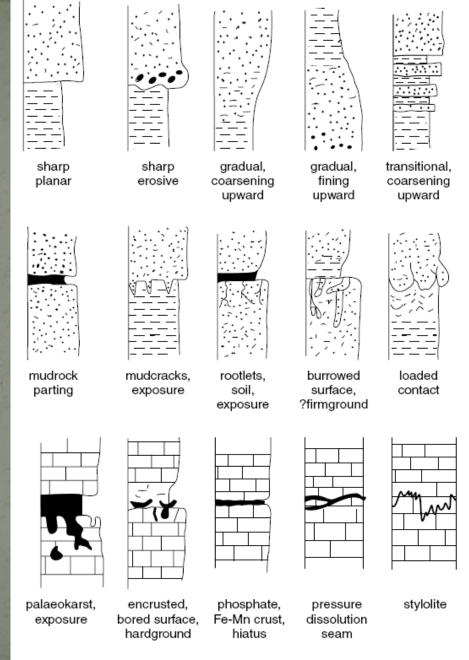


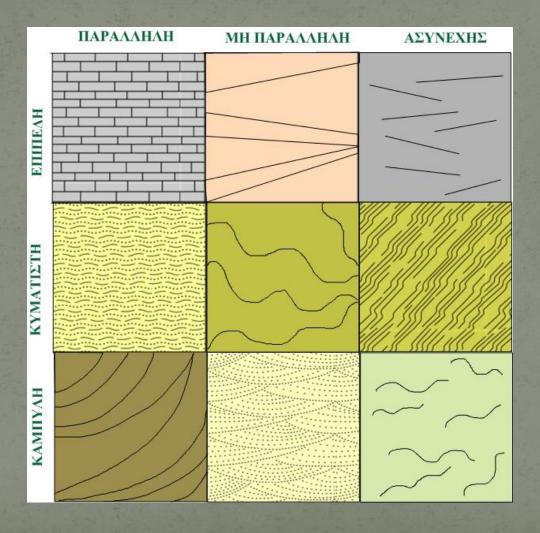
Figure 5.5 Bedding planes and bed contacts: the range of possibilities.

Strata

	type	thickness
	Very thick bedded	>100 cm
	Thick bedded	30-100 cm
Beds	Medium bedded	10-30 cm
	Thin bedded	3-10 cm
	Very thin bedded	1-3 cm
Laminae	laminated	0,3-1 cm
Laiiiiide	Thinly laminated	<0,3 cm



Types of bedding



Διαφορετικοί τύποι στρώσης

Kinds of bedding

- Graded Bedding
- Annual Bedding
- Cyclic Bedding or Cyclothem
- Parallel Bedding
- Cross-bedding or cross-stratification
- Compact Bedding

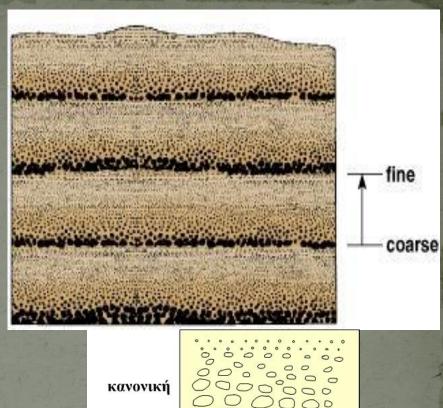
Graded Bedding

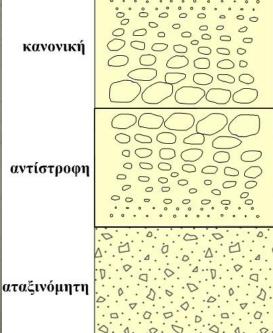
- The grain size in a graded bed is coarser at the bottom and finer at the top.
- Graded bedding results when a sediment-laden current (such as a turbidity current) begins to slow down.
- Three types:

Normal grain sorting (gradual decrease in energy)

Normal grain sorting with fine grains scattered throughout the mass (e.g. Turbidites)

Reverse grain sorting (gradual increase in energy)





Annual Bedding



- Annually recurring and rhythmic bedding
- Alternating coarse-grainedfine-grained sediments
- Each pair corresponds to one year
- Coarse-grained and usually dark-colored - winter deposits
- Fine-grained and usually light-colored - summer deposits

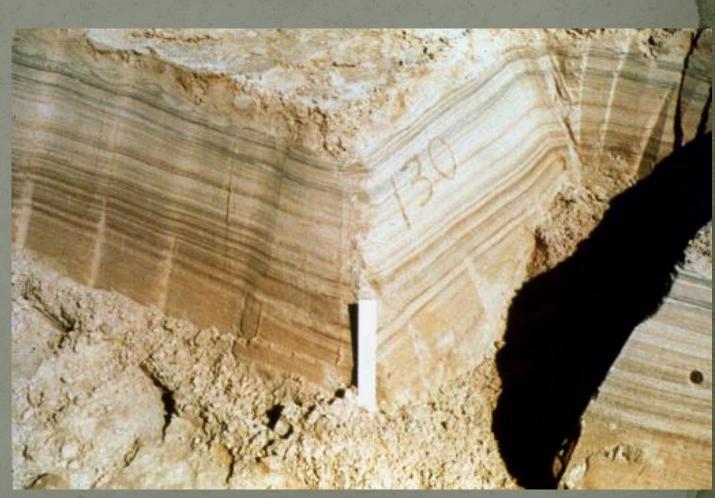
Cyclic Bedding or Cyclothem

Large-scale repeating bedding with the same bed sequences



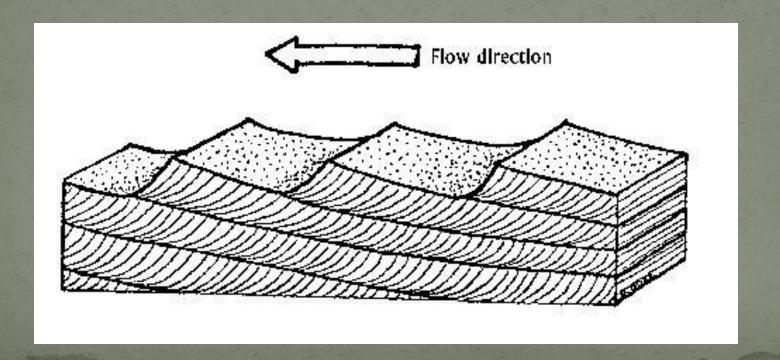
Parallel Bedding

- Rhythmic bedding with laminal parallel beds
- Formation in a calm environment Rhythmic or seasonal conditions of feeding, flow,
- Rhythmites



Cross-bedding or cross-stratification

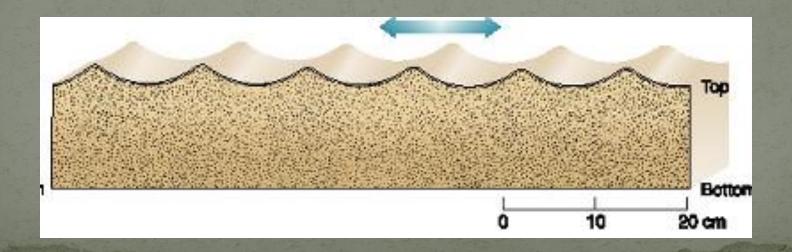
An arrangement of beds or laminations in which one set of layers is inclined relative to the others.



Ripple marks

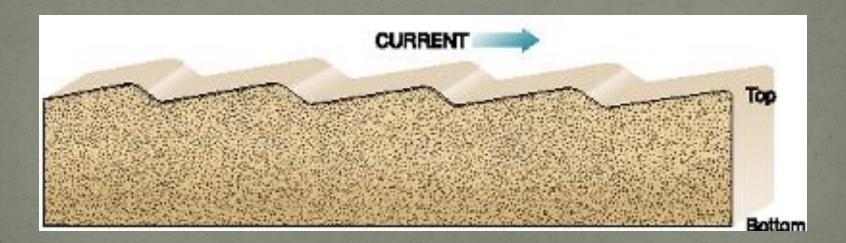
Undulations of the sediment surface produced as wind or water moves across sand.

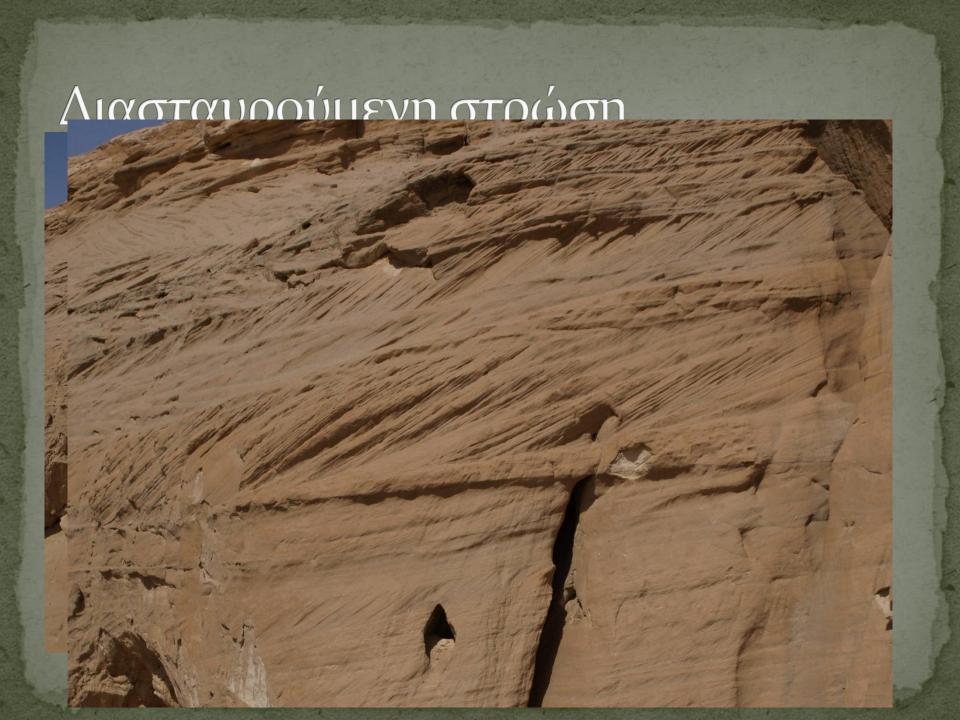
Symmetric ripple marks are produced by waves

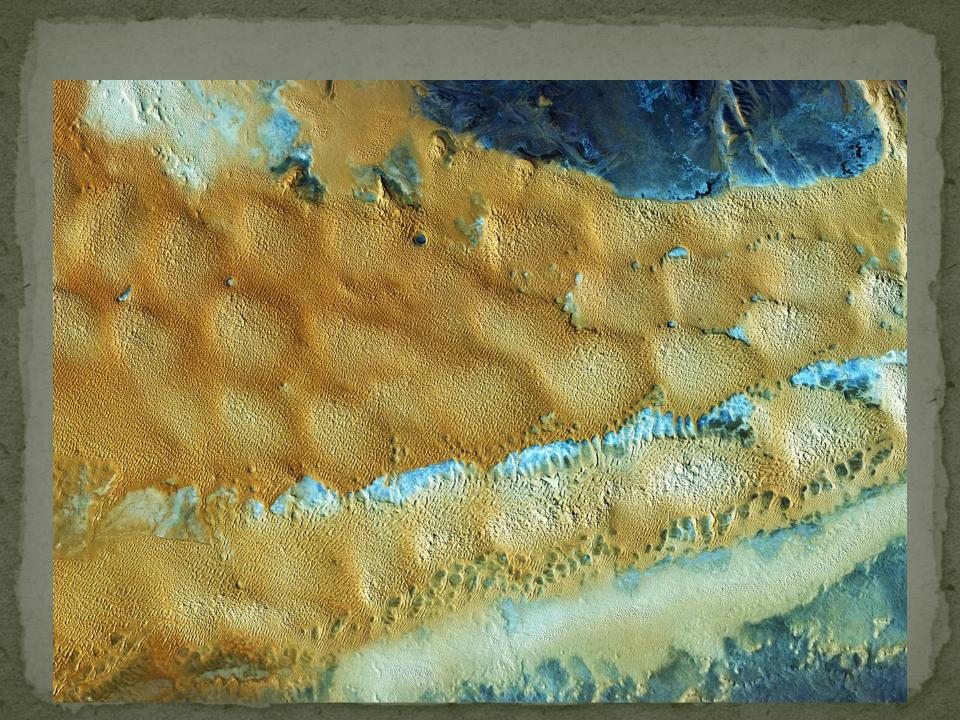


Ripple marks

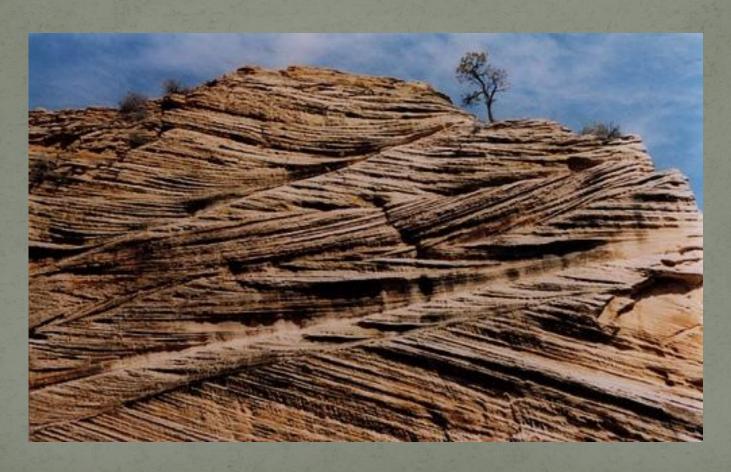
Asymmetric ripples form in unidirectional currents (such as in streams or rivers).







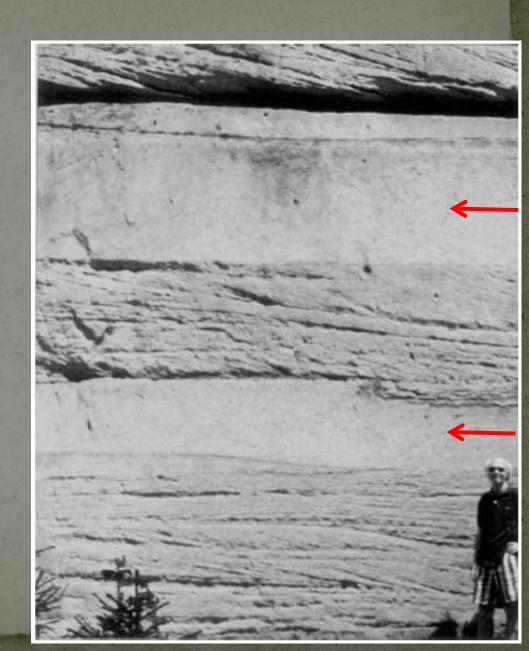
Διασταυρούμενη στρώση 2



Διασταυρούμενη στρώση στο Navajo sandstone

Compact Bedding

- Bedding without internal structure
- Due to rapid deposition of finegrained materials in a calm environment
- Due to recrystallization
- Due to bioturbation



Criteria of superimposition

What happens when we do not have an undisturbed sequence but modified, even inverted, layers?
Using criteria to find the correct position of layers

- Stratigraphic
- Tectonic

Stratigraphic Criteria

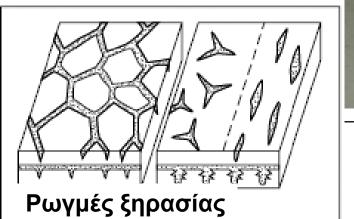
- 1. Local sequence
- 2. Graded bedding
- 3. Cross-bedding
- 4. Discontinuity
- 5. Fossils
- 6. Small stratigraphic structures



- 1. Trace fossils, 2. Dessication cracks,
- 3. Ripple marks, 4. Graded bedding











Ρωγμές ξηρασίας

Γεώδη κελυφών

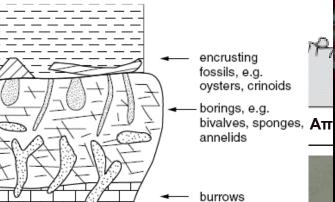


Ίχνη κίνησης

more Fe-rich

wellcemented

less wellcemented



Pamela Gore 1985

Ασυνέχειες

Stratigraphic section

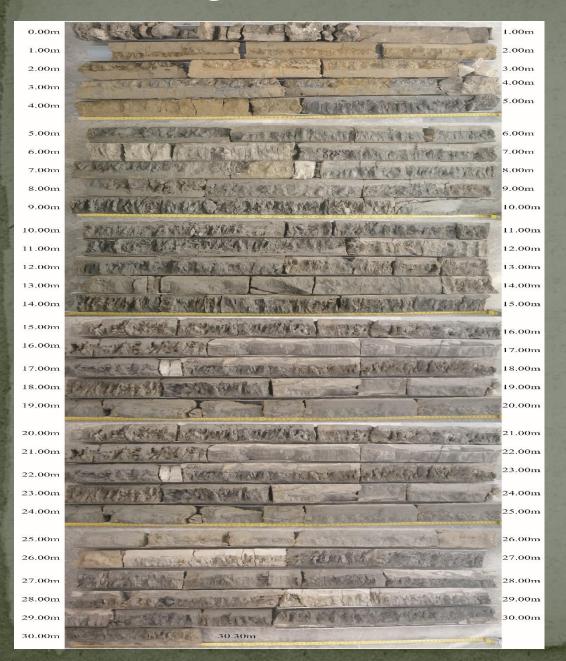
- The graphical representation of lithological, and structural components such as thickness, fossil content, of a certain sequence in a certain position
- Basic element and foundation of any geological study
- Data collected from:
- Natural sections
- 2. Artificial sections
- 3. Drillings
- 4. Geophysical tomographies



Artificial section



Drillings



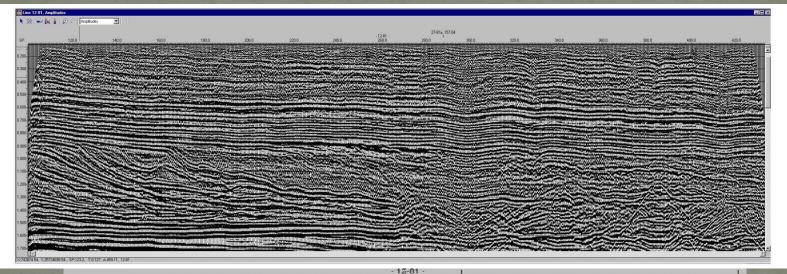


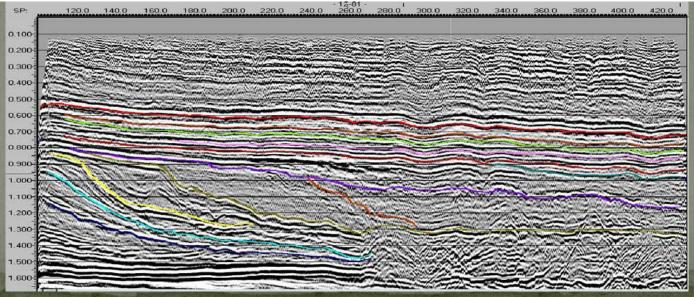




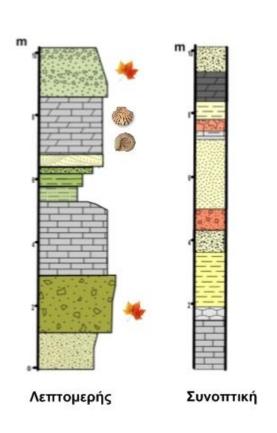


Geophysical tomographies





Detailed – Brief Stratigraphic collumn



In the detailed stratigraphic column, the variations in grain size are depicted as well as the transition from one layer to another, in contrast to the brief one in which the changes in the sediments are shown by the different symbolism and the transitions are not clear.

Construction of a stratigraphic section

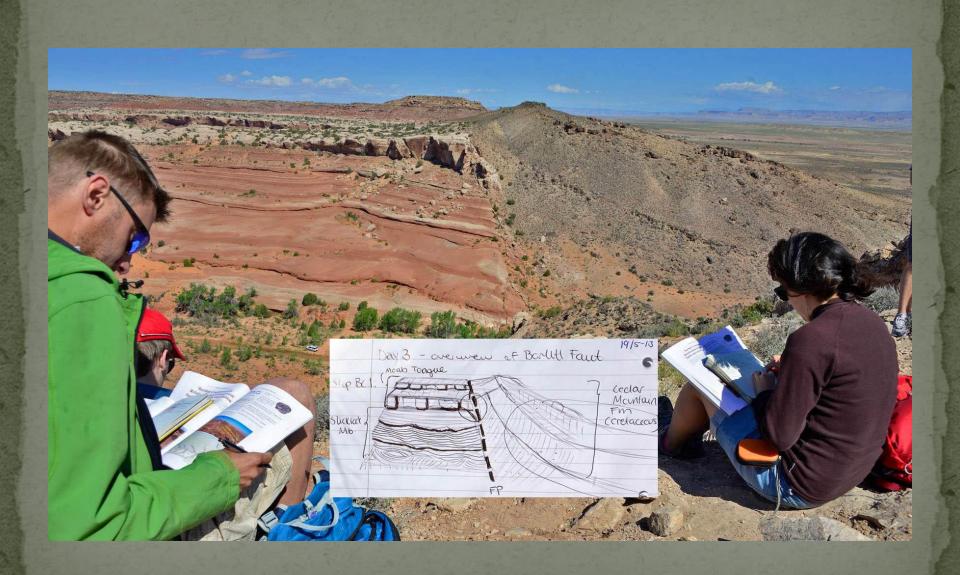
- 1. Field stage
- 2. Laboratory stage
- 3. Stratigraphic section construction





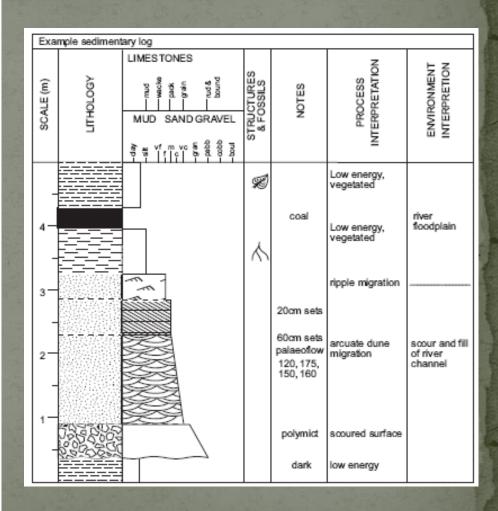
Wot the well-dressed 'ologist is wearing this summer





Στάδιο υπαίθρου

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INTERNATIONAL CHRONOSTRATIGRAPHIC CHART

International Commission on Stratigraphy

v **2023**/06



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		as		Middle	Bajocian Aalenian	170.9 ±0.8
		Jurassic				174.7 ±0.8
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	20				Sinemurian	199.5 ±0.3
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		Sn	nsy	Middle	Moscovian	315.2 ±0.2
		iferous	Pennsylvania	Lower	Bashkirian	2
		nif		Linner	Serpukhovian	323.2 ±0.4
		00	ssippian	Upper	Serpukriovian	330.9 ±0.2
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	EO,	20	poing,		J														
Fonother	trathen,	System	Series / Epoch	Stage / Age	GSSP	numerical age (Ma) 358.9 ±0.4													
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		vonia	Middle	Givetian	3	387.7 ±0.8													
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			Pridoli		3	423.0 ±2.3													
			Ludlow	Ludfordian	3	425.6 ±0.9													
		an		Gorstian		427.4 ±0.5													
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		a B		Stage 4															
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			Ediacaran	3	538.8 ±0. ~ 635
		Neo- proterozoic	Cryogenian	1	~ 720
		proterozoic	Tonian		1000
			Stenian		1200
	<u>.</u>	Meso- proterozoic	Ectasian		1400
	OZO		Calymmian		1600
	Proterozoic		Statherian		1800
rian	<u>P</u>	Paleo-	Orosirian		2050
amb		proterozoic	Rhyacian		2300
Precambrian			Siderian		2500
		Neo- archean		Ĭ	
	Archean	Meso- archean		_O	2800
	She			⊸ ⊘	3200
	Arc	Paleo- archean			
		Eo- archean		<u> </u>	3600
		archeart		(2)	4000
	На	dean			1 (887.73)
חהח					4567

Units of all ranks are in the process of being defined by Global Soundary Stratotype 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 informat units and placeholders for unnamed units. Versioned charts and detailed information or ratfield GSSPs are available at the website http://www.stratigraphy.org. The URL b this chart is found below.

Numerical ages are subject to revision and do not define units in the Phanerozoic and the Ediacaran; only GSSPs ot. For boundaries in the Phanerozoic without ratified GSSPs or without constrained numerical ages, an approximate numerical age (~) is provided.

Ratified Subseries/Subepochs are abbreviated as U/L (Upper/Late), M (Middle) and L/E (Lower/Early), Numerical ages for all systems except Quatemary, upper Paleogene, Cretaceous, Jurassic, Triassic, Permian, Cambrian and Precambrian are taken from 'A Geologic Time Scale 2012' by Gradstein et al. (2012), those for the Quaternary, upper Paleogene. Cretaceous, Jurassic, Triassic, Permian, Cambrian and Precambrian were provided by the relevant ICS subcommissions.

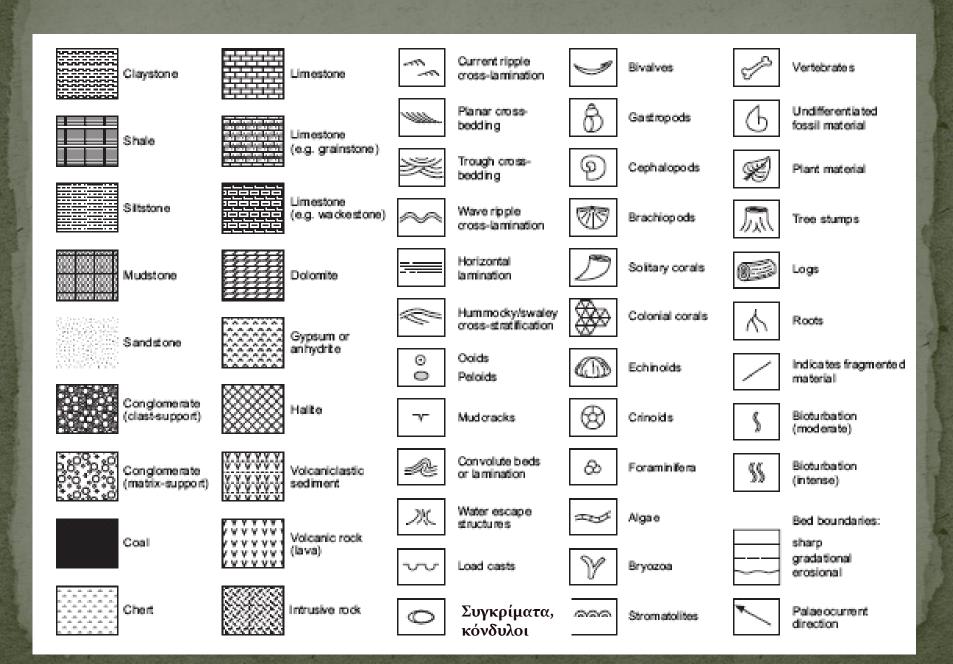
Colouring follows the Commission for the Geological Map of the World (www.ccgm.org)



Chart drafted by K.M. Cohen, D.A.T. Harper, P.L. Gibbard, N. Car (c) International Commission on Stratigraphy, June 2023

To cite: Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; updated)
The ICS International Chronostratigraphic Chart. Episodes 36: 199-204.

URL: http://www.stratigraphy.org/ICSchart/ChronostratChart2023-06.pdf



Completeness of rock record

- The rock record is the set of rocks that have been deposited (sedimentary record) or formed in a specific area or across the planet.
- The record is always incomplete and discontinuous
- Why?

Incomplete rock record

- It is most often interrupted by countless Discontinuities, Unconformities or diastemas
- Rocks are destroyed by various exogenous and endogenous processes
- The deposition or formation of rocks is often interrupted by such processes
- Such temporary and short interruptions are found, as we said earlier, on each layer surface.
- The elements that the rocks contain in these interruptions are also part of Stratigraphy and a very important contribution to understanding the history of our planet.

Discontinuities

Any change/interaption in the lithological continuity or coherence of a layer.

Two types

- 1. Stratigraphic
- 2. Tectonic

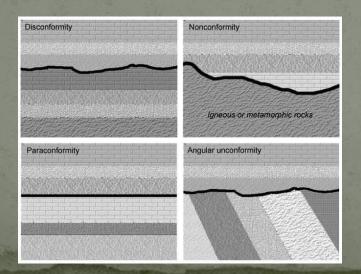
Stratigraphic Discontinuities

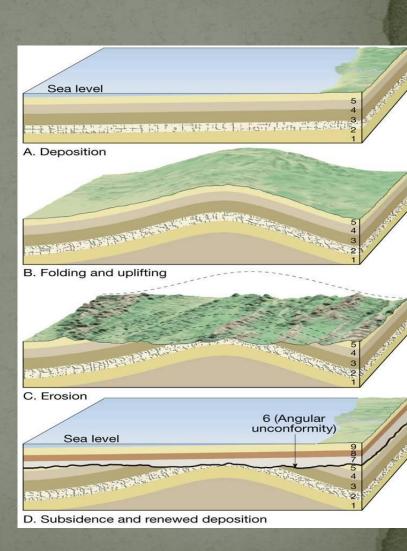
- A. Bed contacts
- B. Unconformities
- C. Diastems

Unconformities

«the stop of sedimentation for a significant time period»

- Nonconformity
- 2. Angular conformity
- 3. Disconformity
- 4. Paraconformity



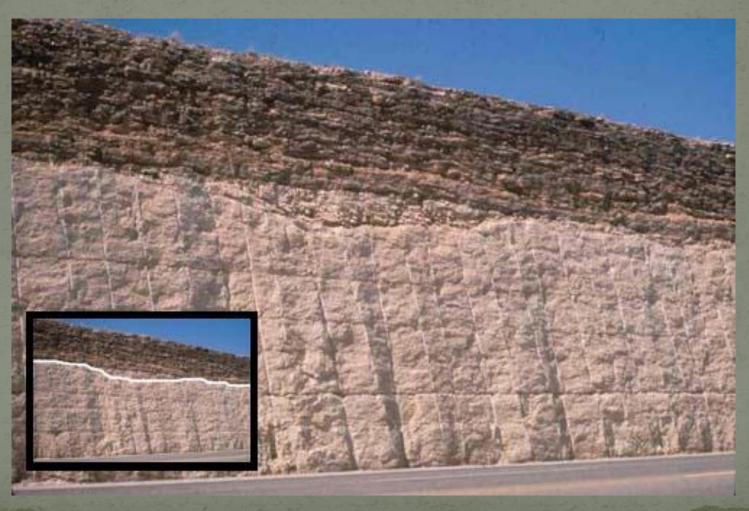


Angular conformity



Γωνιώδης ασυμφωνία

Nonconformity



Συνεχής ασυμφωνία

Disconformity



Διαβρωσιγενής ασυμφωνία

Paraconformity



Παρα- ασυμφωνία

diastema



Πρωτογενείς ασυμφωνίες στο Grand Canyon

Diastema

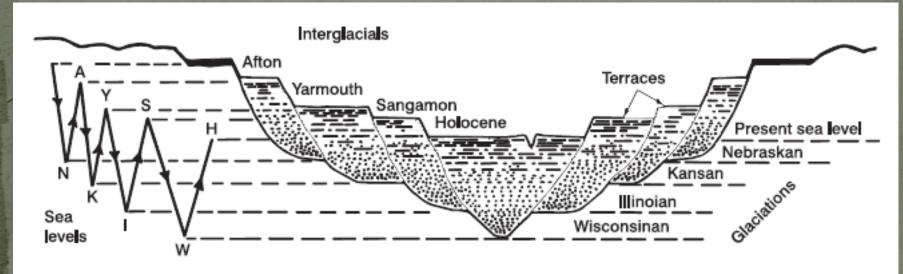


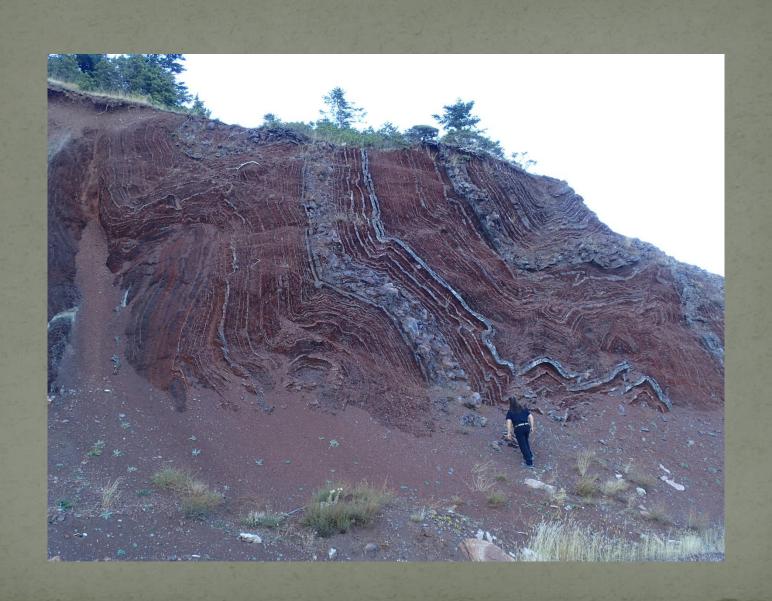
Fig. 5.13 Interglacial terraces and glacial valley cutting, lower Mississippi River, USA (from Strahler 1971, fig. 41.18).

Tectonic Discontinuities

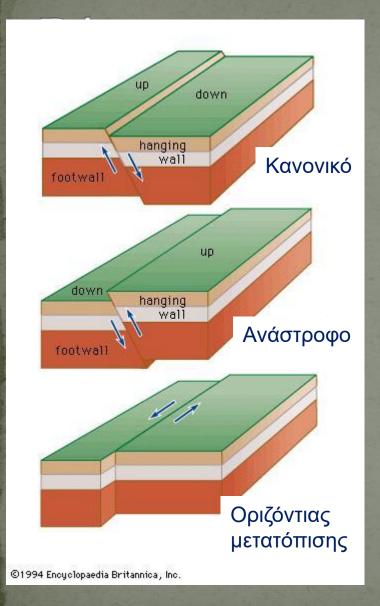
- 1. faults
- normal
- reverse
- strike slip
- 2. high angle thrusts
- 3. low angle thrusts

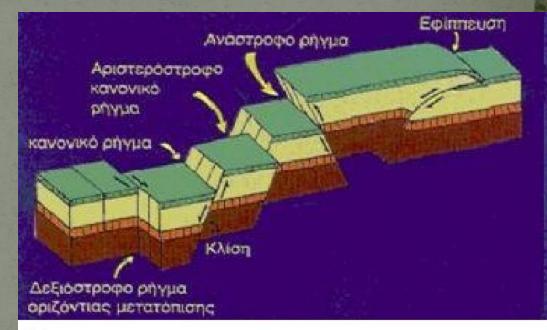
thrusted sheets and nappes







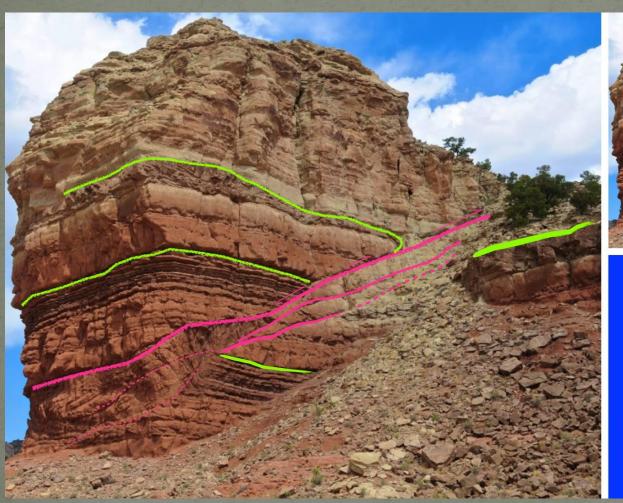




<u>Ρήγμα</u>: διάρρηξη (σπάσιμο) στο φλοιό της γης. Υπάρχουν τρία είδη ρηγμάτων: 1. Κανονικά ρήγματα, 2. Ανάστροφα ρήγματα, 3. Ρήγματα οριζόντιας μετατόπισης.



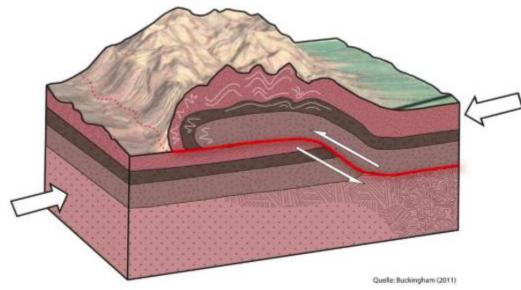




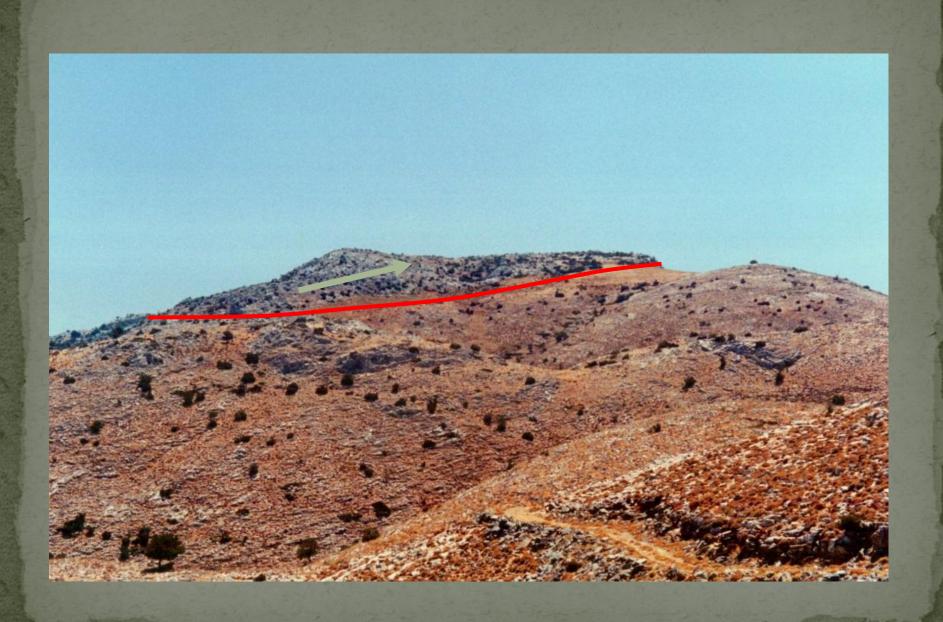


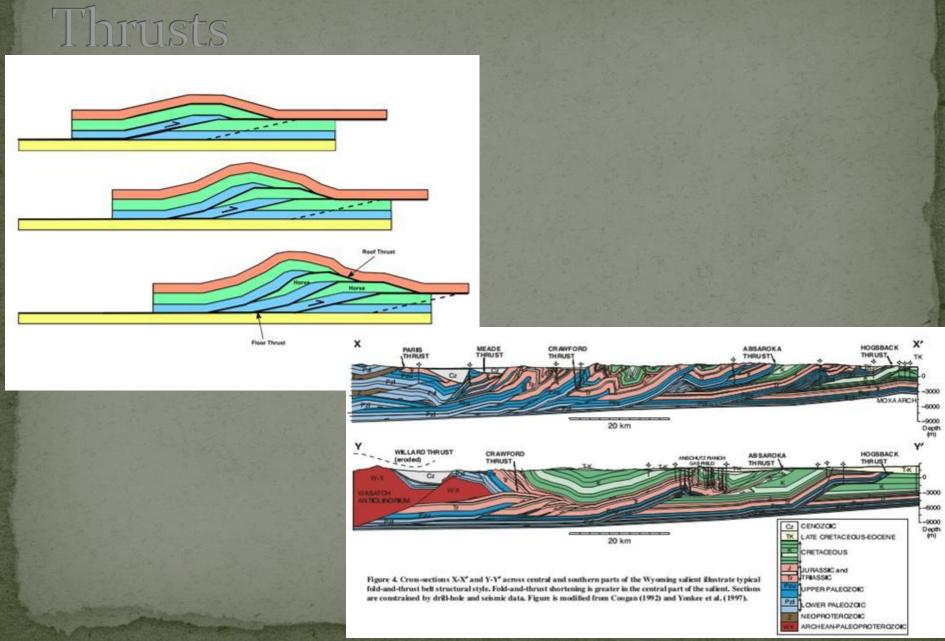
an interpretation of the Reverse Fault (fault zone) at Cedar Mountain, Utah, USA.











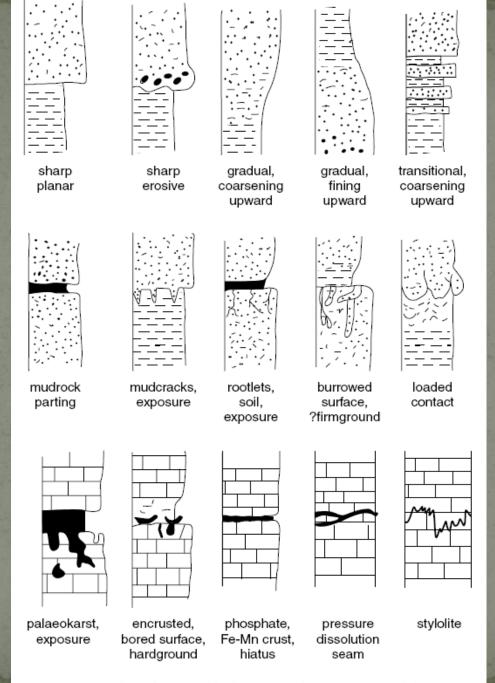


Figure 5.5 Bedding planes and bed contacts: the range of possibilities.