

EPSC 240: GEOLOGY IN THE FIELD

# INTRODUCTION TO STRATIGRAPHY



## ANNOUNCEMENT

*Do you love science and want to get involved in the  
research process?*

**The McGill Science Undergraduate Research  
Journal is looking for *editors!***

**We are a student-run, peer-reviewed scientific journal that  
publishes undergraduate research papers and reviews.**

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Applications due *Friday, September 28th, 2018*

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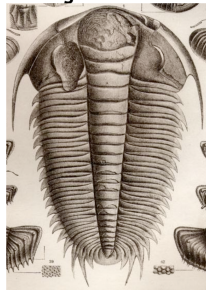
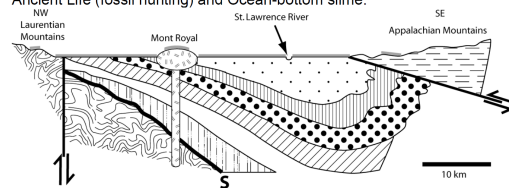
McGill University  
Earth and Planetary Sciences/Earth System Sciences

First year field trip

September 21, 2018 (Friday) All day (8:30 to 5:00)

See some of the local Geology; Get a free lunch  
Contact [william.minarik@mcgill.ca](mailto:william.minarik@mcgill.ca) if you're interested in going!

The remnants of Volcanoes, Glaciers,  
Ancient Life (fossil hunting) and Ocean-bottom slime.

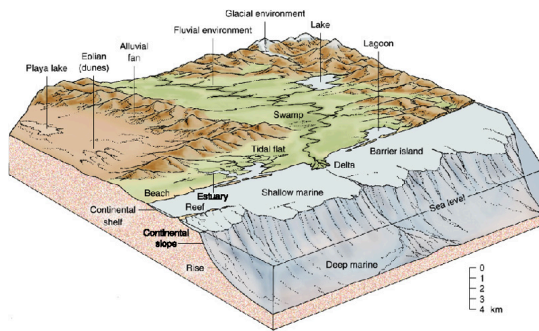


## KEY POINTS:

- Sedimentary rocks form in layers by sedimentation
- The components and structures in the rocks tell us about depositional environment
- Stratigraphy records changes in environment over time

## SEDIMENTARY ROCKS

- Rocks that formed by a process of **sedimentation** at the Earth's surface



1. Weathering/ erosion
2. Transport
3. Deposition
4. Compaction
5. Lithification

## HOW DO WE KNOW?

- The present is the key to the past (James Hutton)
- **Uniformitarianism**



Source: wikipedia

## SUPERPOSITION

- Sedimentary rocks are generally deposited in layers
- Younger layers are deposited on top



## SEDIMENT

- The basic components of a sedimentary rock are the pieces of sediment that get deposited



- **Clastic**
- **Bioclastic**
- **Chemical**

## SEDIMENTARY ROCKS

- Grain size(s); relative abundance if different size classes (sorting)
- Color, mineralogy of grains
- Grain shape (angular/rounded, spherical or elongate?)
- Assign a rock name (or sediment name, if not lithified)



## SEDIMENTARY STRUCTURES

- Erosional - effects of transport and scour of sediment
- Depositional - the way in which each grain is laid down, then buried
- Post-depositional - slumping, fluidization, reactions with ground water
- Biogenic - animals did it

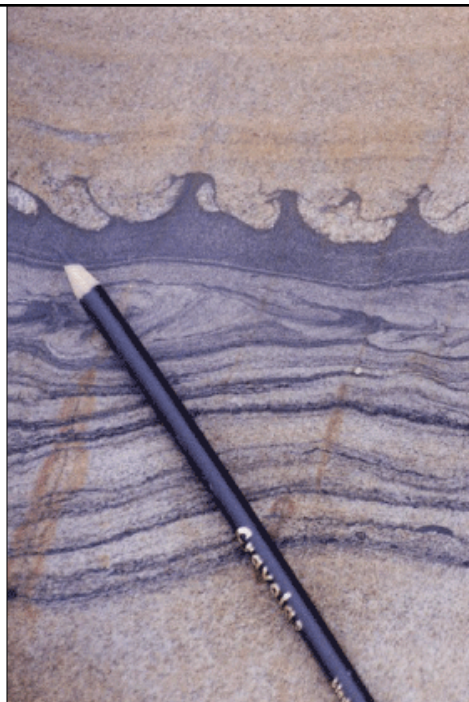
## CONTACTS = SUPER IMPORTANT

- Marking changes in depositional system
- Sharp or gradational? Horizontal or progressive?
- Compare from place to place - are they markers of time? or space? or both?



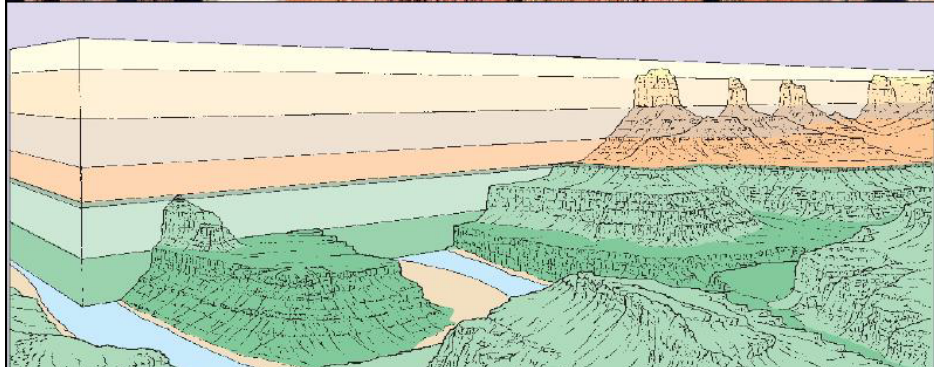
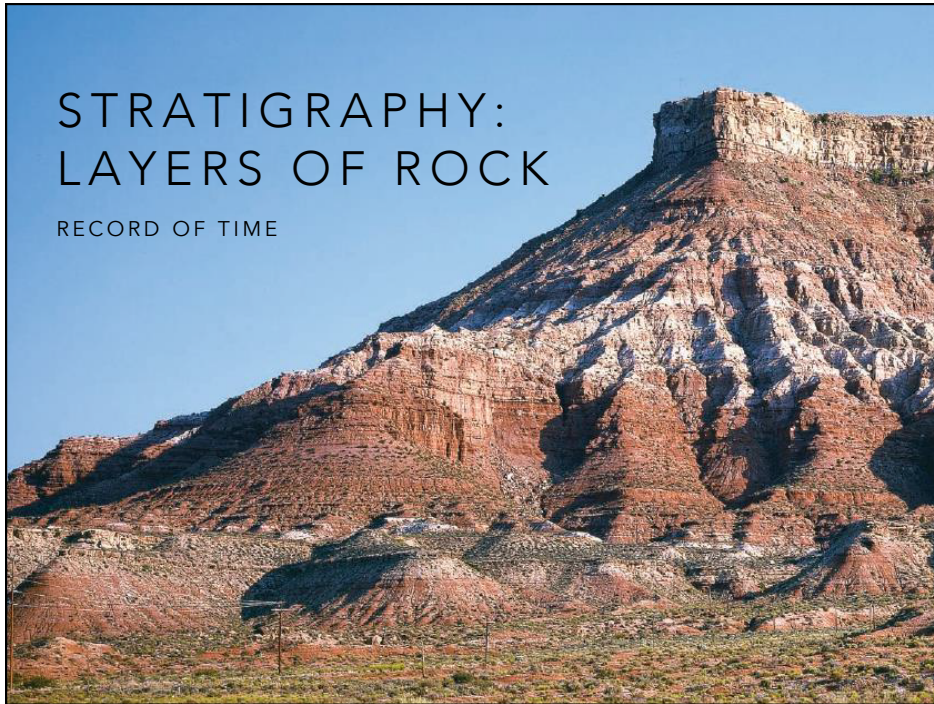
## WHAT SEDIMENTARY STRUCTURES TELL US

- Which way is up / younger
- Ancient direction of wind or water flow
- Energy of the depositional environment
- What lived there
- Nearby environments and their bedrock geology (sources of sediment)



# STRATIGRAPHY: LAYERS OF ROCK

RECORD OF TIME





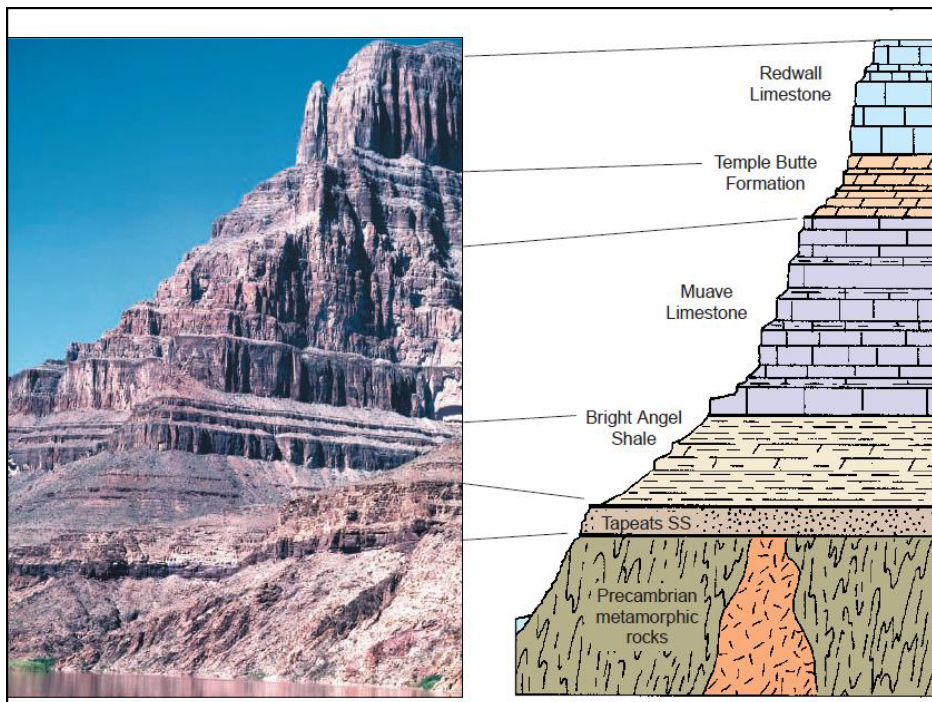
## GENERAL CHARACTERISTICS

- Rocks are layered (applies to sediments and volcanics)
- Younger units on top, older ones on the bottom (principle of superposition is obeyed)
- Minimal structural deformation or disturbance of rock layers

## UNCONFORMITIES

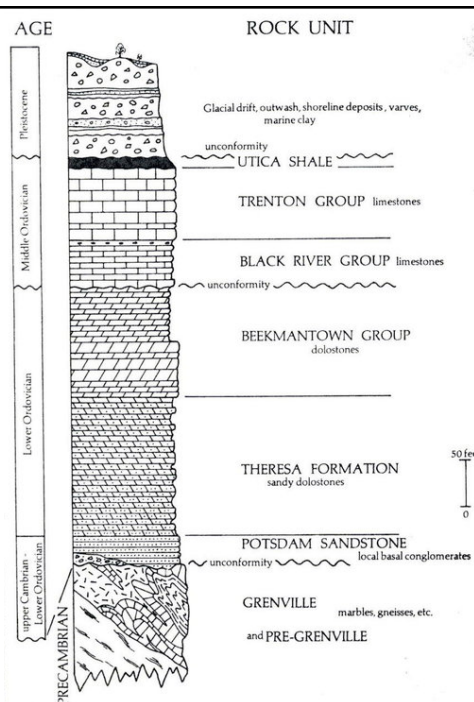
- A contact separating rocks of different ages  
→ no deposition and/or erosion of this contact between times of deposition





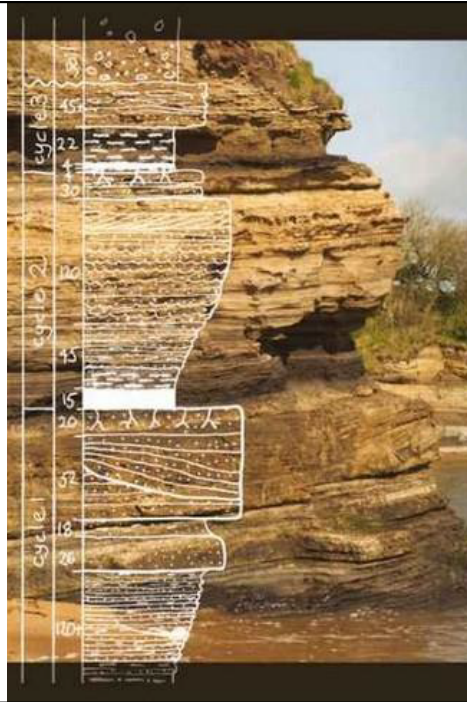
## CONTACTS

- Angle of contact schematically imitates true dip of contact
- Represent cross cutting relationships
- Unconformities (time gap in deposition, erosion has occurred before younger deposit)

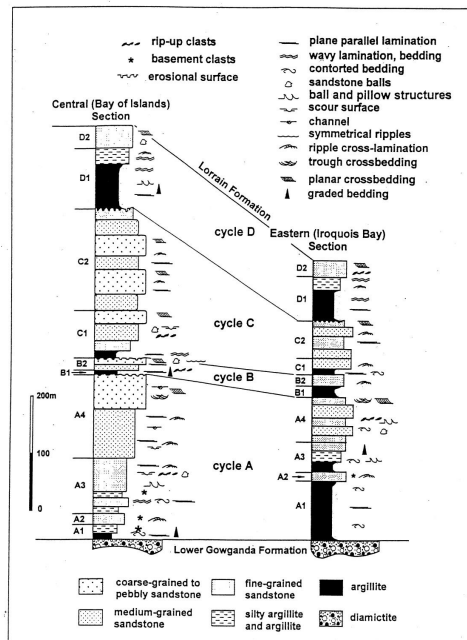


## GRAPHICAL REPRESENTATION

- Rock types shown with symbols
- Details of rock (e.g., bedding structures, fossils, grain size) shown with symbols
- Height of units scaled to true relative thickness
- Important time divisions are labeled as possible
- Names of each unit



### Examples of measured stratigraphic sections



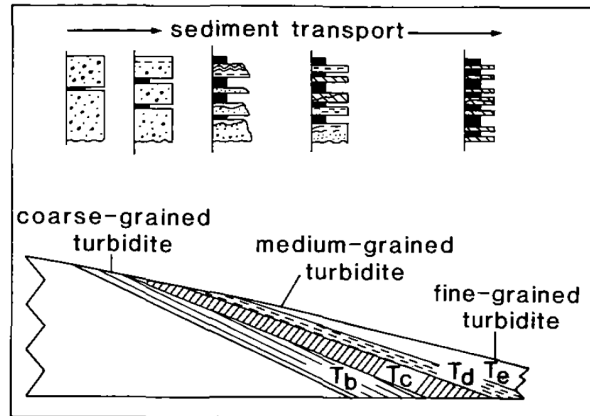
Names of each unit or bed

Can put special symbols inside units or along side

CHARACTERISTIC SEQUENCES OF SEDIMENTS =

# ASSEMBLAGES

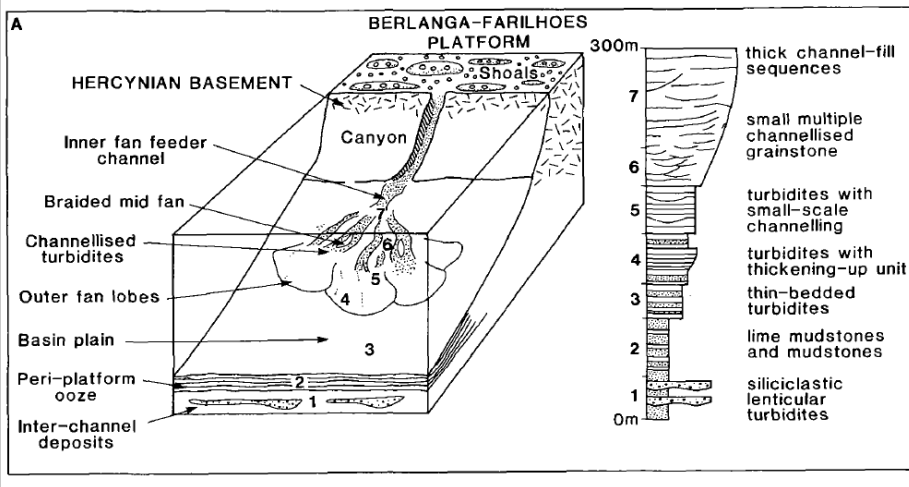
- At any point in time, different rocks are being deposited in different places
- Over time, the places of deposition move
- A strat column is vertical but reflects lateral changes



Time →

JURASSIC SEDS, PENICHE, PORTUGAL

## USE STRAT COLUMN TO INTERPRET DEPOSITIONAL ENVIRONMENT



# COLLECTING DATA

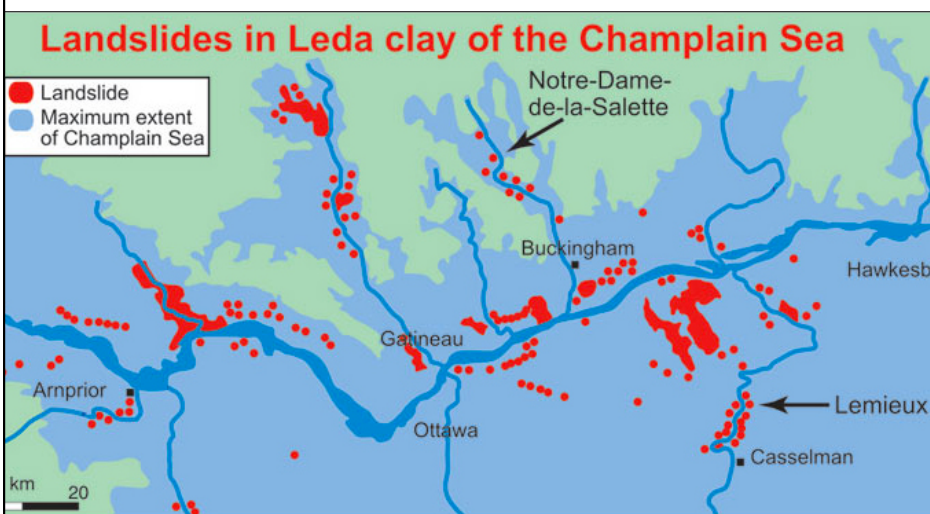
1. **Study the outcrop(s)** from which you will collect data to construct the stratigraphic column
2. **Decide on scale** of units/level of detail to use - appropriate to your purpose
3. **Measure total thickness** of section - this is the vertical axis of the strat column
4. **Measure units or beds** within section - make sure total adds up to total thickness
5. Make **detailed notes/sketches/photo** documentation of each unit
6. Determine relative **weathering profile** (schematic curve down your section)
7. Find or create **appropriate symbols** for rock type, sedimentary structures, fossils, etc.
8. Make sure you have complete **legend and scale**

lithotypes		sedimentary structures		LITHOLOGY		
conglomerate (cgl)	erosional flutes	post-depositional flame structures	clay, mudstone	litharenite	limestone	chert
sandstone (sst)	erosional grooves	post-depositional sediment injection	shale	greywacke	dolomite	peat
siltstone (slt)	erosional scour & fill	post-depositional shale clasts	mudstone (md)	clayey sandstone	sandy limestone	brown coal (lignite)
claystone (cy)	erosional load cast	post-depositional load casts	limestone (lst)	calcareous sandstone	intraclast	hard coal
dolomite (dol)	depositional structureless (massive)	post-depositional pseudonodules	chert (cht)	siltstone	alternating strata sandstone/shale	symbols to add: ooid
coal (ct)	depositional parallel bedding	post-depositional convolute/contorted lam. (syn. = syneresis)	halite (hal)	sandstone	pebble-supported conglomerate	oncolid/pisoid > 2 mm diameter
gypsum, anhydrite (gyp, anhy)	depositional parallel lamination	post-depositional mud cracks (syn. = syneresis)	volcaniclastite	quartz arenite	matrix-supported conglomerate	peloid
closely interbedded lithotypes; width of ornament indicates proportion of each	depositional wavy bedding	post-depositional water-escape pipes	gypsum, anhydrite (gyp, anhy)	arkose	fossils (undiff.) for specific symbols see below	fossils (undiff.) for specific symbols see below
<b>qualifiers</b>	depositional wavy lamination	post-depositional water-escape dishes	dolomite			
pebbly	depositional inclined bedding/lam.	post-depositional microfault	cherty			
silty	depositional cross bedding/lam. (tab = tabular tr = trough)	post-depositional filled fracture	carboniferous			
muddy	depositional nodule/concretion	post-depositional nodule/concretion	saliferous			
calcareous	erosional flute cast	post-depositional biogenic bioturbation minor (0-30%)	gypsiferous			
dolomitic	erosional groove cast	post-depositional biogenic bioturbation moderate (30-60%)	tuffaceous			
cherty	erosional tool marks	post-depositional biogenic bioturbation intense (>60%)	fossiliferous			
carboniferous	erosional load casts	post-depositional biogenic burrow traces	fossiliferous			
saliferous	erosional shrinkage cracks	post-depositional biogenic rootlets	fossiliferous			
gypsiferous	erosional striations/lineations	post-depositional biogenic algal mound	fossiliferous			
tuffaceous	erosional symmetrical ripples	post-depositional biogenic tracks & trails	fossiliferous			
fossiliferous	erosional asymmetrical ripples	post-depositional biogenic borings	fossiliferous			
<b>fossils</b>	erosional flute cast	post-depositional biogenic fossil fragments	fossiliferous			
fossils (undifferentiated)	erosional groove cast	post-depositional biogenic structure indistinct	fossils (undifferentiated)			
fossils - broken	erosional tool marks	post-depositional biogenic structure very indistinct	fossils - broken			
ammonoids	erosional load casts	post-depositional biogenic interval over which structure occurs	ammonoids			
belemnites	erosional shrinkage cracks	post-depositional biogenic disturbed section	belemnites			
brachiopods	erosional striations/lineations	erosional flute cast	brachiopods			
bryozoa	erosional symmetrical ripples	erosional groove cast	bryozoa			
coral - solitary	erosional asymmetrical ripples	erosional tool marks	coral - solitary			
coral - compound	erosional flute cast	erosional load casts	coral - compound			
crinoids	erosional groove cast	erosional shrinkage cracks	crinoids			
echinoids	erosional tool marks	erosional striations/lineations	echinoids			
gastropods	erosional load casts	erosional symmetrical ripples	gastropods			
	erosional shrinkage cracks	erosional asymmetrical ripples				
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	erosional tool marks	erosional striations/lineations				

# CHAMPLAIN SEA



# LANDSLIDES



# WEDNESDAY

## **Bus leaves Milton Gates at 1:35 pm SHARP**

- About 1 hour to quarry. Pit stop stop nearby.

### BRING

- Water, snack
- Notebook, hand lens, acid bottle
- Sharp pencils, fineline black pen, coloured pencils, ruler
- Optional: ziplock bags & spoon for sampling

### WEAR

- Something you don't mind getting dirty
- Long pants, shoes for walking/climbing, sunscreen

ASSIGNMENT HANDOUT, READINGS!