Geologic Structures
(sedimentary, igneous, deformation)
and Deformation Regimes

Processes in Structural Geology & Tectonics

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Rock Stories: Unconformity

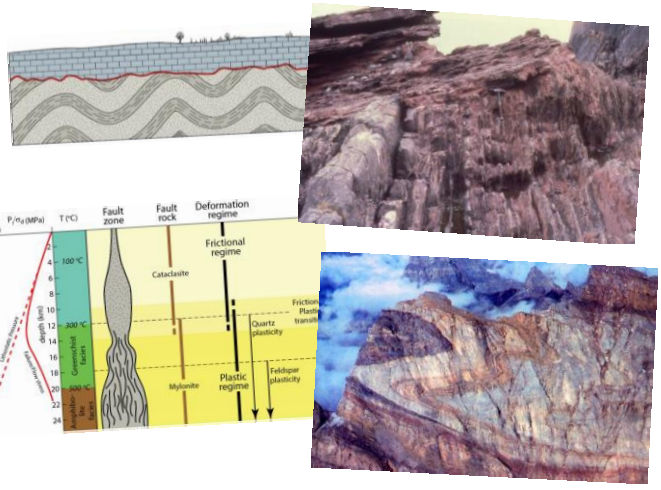
If there is an interruption in sedimentation, creating a gap in time between the base of a geologic unit and what lies beneath it, we say that the contact is unconformable.
Such contacts are referred to as unconformities, and the gap in time represented by the unconformity (the difference in age between the base of the strata above and the top of the unit below) is called a hiatus.
Well-known unconformities are the Great Unconformity, US Grand Canyon, and the Caledonian unconformity, Scotland.

The Great Unconformity, US Grand Canyon, separates Cambrian Tapeats Sandstone from Proterozoic rocks below. It represents ~1.2 billion years of missing rock record, due to erosion and non-deposition.
https://bit.ly/2RbAOKc

We Discuss …

Geologic Structures and Deformation Regimes

- Depositional Structures
- Unconformities
- Salt Structures
- Volcanic Structures
- Impact Structures
- Deformation Structures
- Deformation Regimes
  - Frictional Regime
  - Plastic Regime



Stratigraphic Facing ("up")

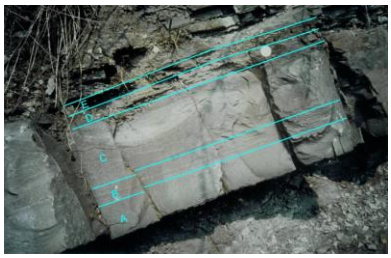
(a)

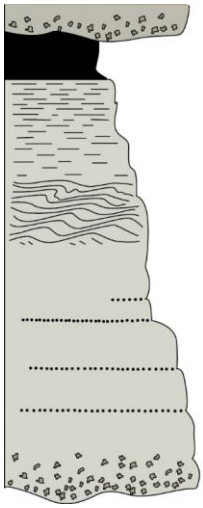
a. Ripple marks
b. Cross beds (AZ)
c. Pillow basalt (CA)

(b)

(c)

Turbidites





E (h) Hemipelagic mud

E (t) Turbidite mud

(D)

C Rippled bed, convoluted laminae

B Planar laminae

A Massive, graded bed

Depositional Structures

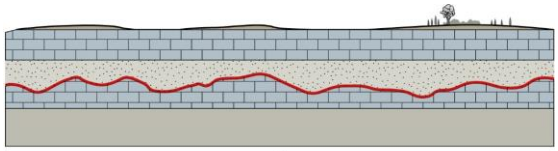
Penecontemporaneous (syn-depositional) or slump folds (El Gordo; S Spain).

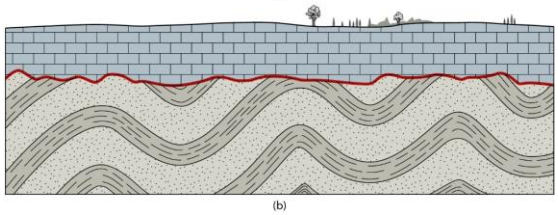
Heart Mountain detachment; subaerial landslide of Paleozoic carbonates on Eocene deposits (Wyoming).

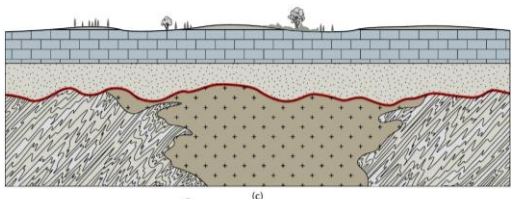
Depositional Structures

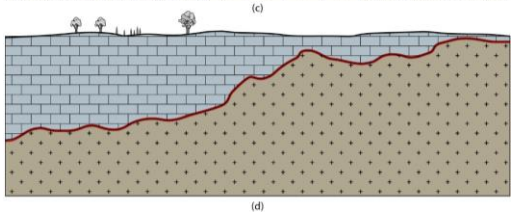
a. Disrupted bedding (Spain)
b. Load casts (Germany)
c. Clastic Dyke (Canada)

Unconformities



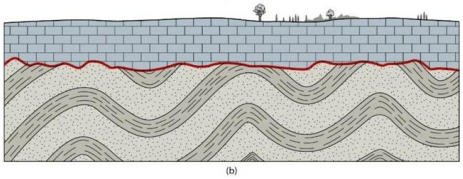




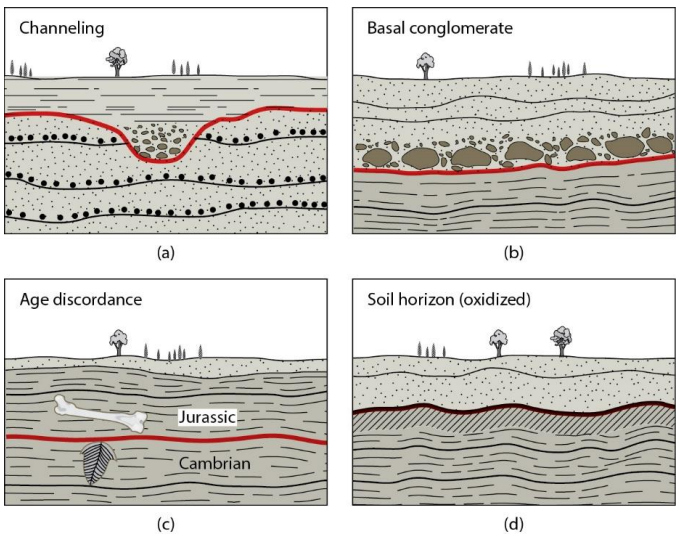


a) Disconformity
b) Angular unconformity
c) Nonconformity
d) Buttress unconformity

Angular Unconformity



Identifying Unconformities



Features to identify unconformities:

a) scour channels in sediments
b) basal conglomerate
c) age discordance from fossil evidence
d) soil horizon or paleosol

Igneous Structures

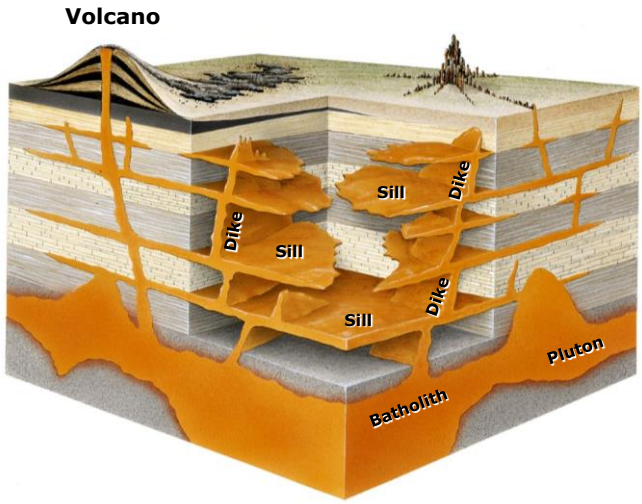
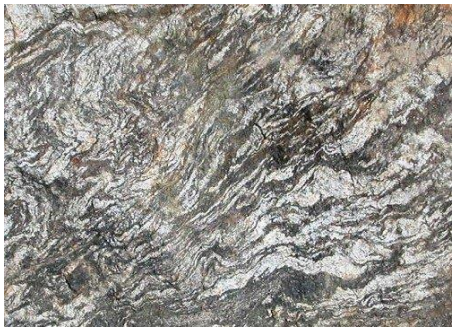


TABLE 2.6	TERMINOLOGY OF IGNEOUS INTRUSIONS
Batholith	A huge bloblike intrusion; usually a composite of many plutons.
Dike	A sheet intrusion that cross cuts stratification in a stratified sequence, or is roughly vertical in an unstratified sequence.
Hypabyssal	An intrusion formed in the upper few km of the Earth's crust; hypabyssal intrusions cool relatively quickly, and thus are generally fine grained.
Laccolith	A hypabyssal intrusion that is concordant with strata at its base, but bows up overlying strata into a dome or arch.
Pluton	A moderate-sized bloblike intrusion (several km in diameter). Sometimes the term is used in a general sense to refer to any intrusion, regardless of shape or size.
Sill	A sheet intrusion that parallels preexisting stratification in a stratified sequence, or is roughly subhorizontal in an unstratified sequence.
Stock	A small, bloblike intrusion (a few km in diameter).

Igneous Structures



a)

b)

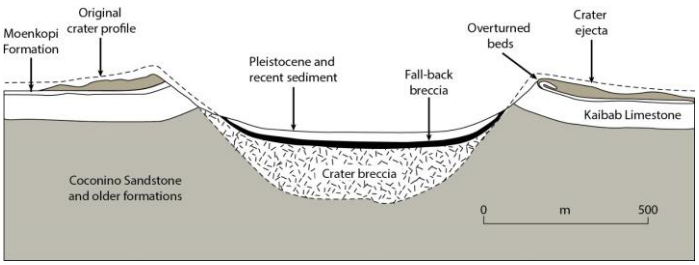
c)

a) Migmatite showing complex folding and disruption.
b) Pillow basalt from Port San Luis Pier (CA)
c) Columnar jointing at Massif central (France)

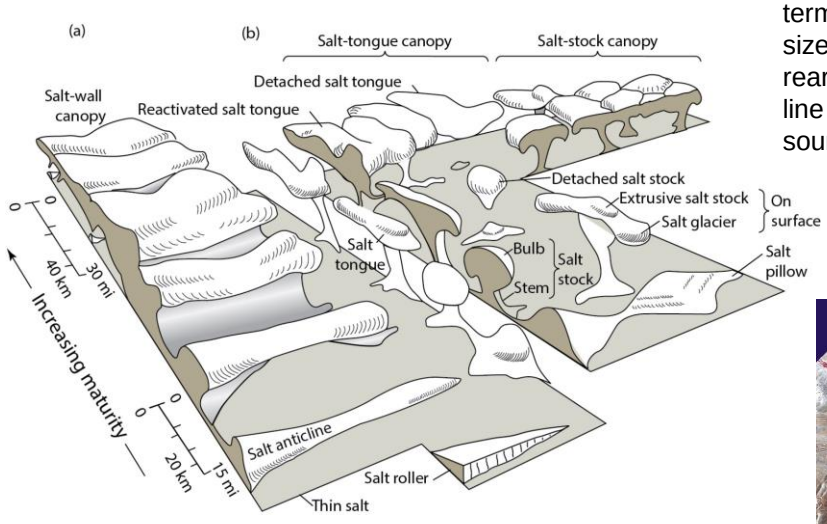
Impact Structures

Barringer Meteor Crater of Arizona (50 Ka)

Shatter cones of Sudbury impact (1.85 Ga)



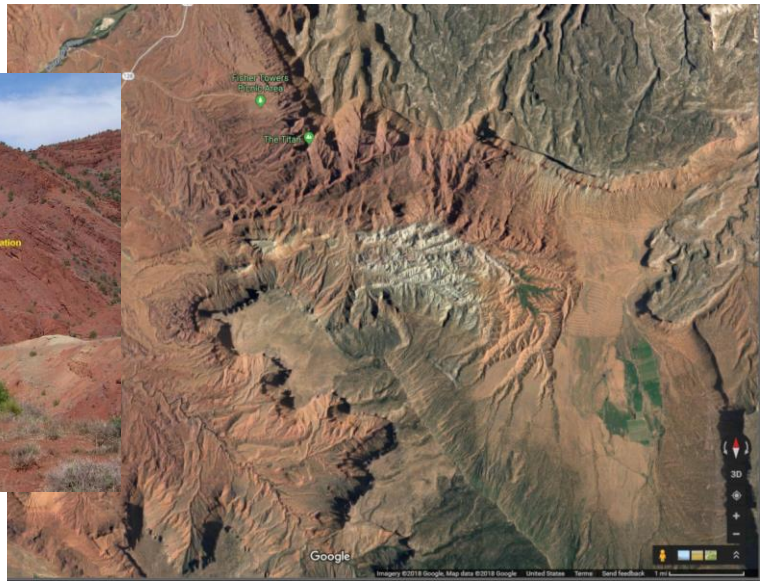
Salt Structures



Formation of salt structures and terminology. Structural maturity and size increase toward structures in rear; (a) shows structures rising from line sources, (b) originate from point sources.

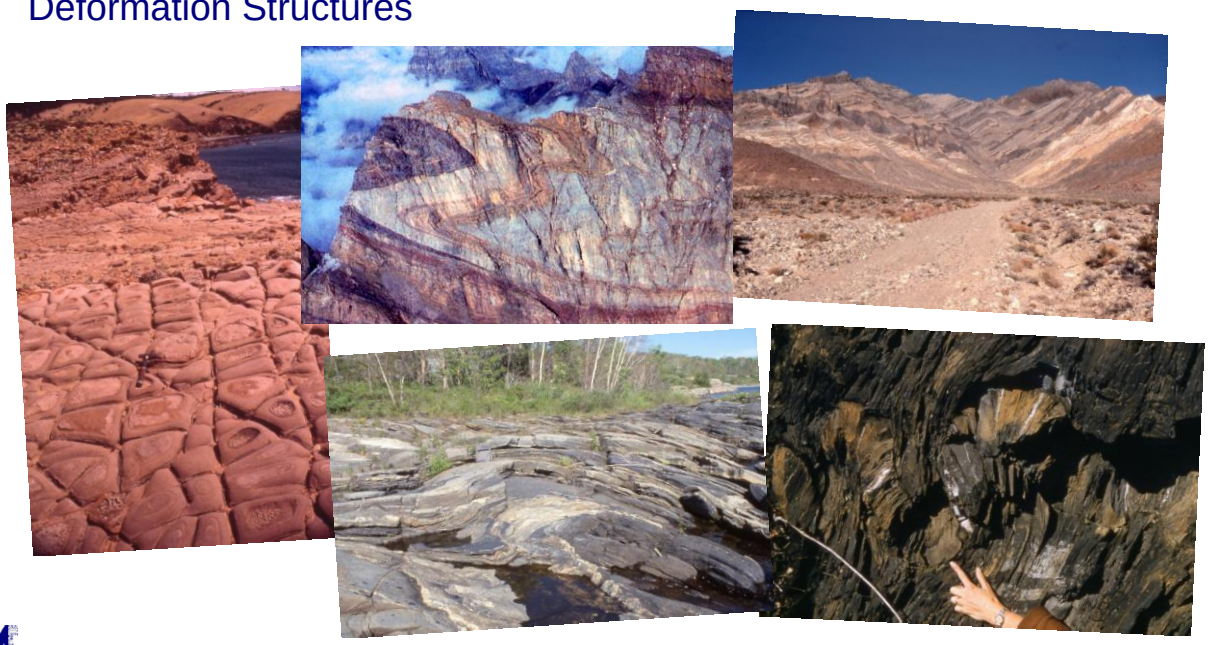
Salt domes and salt glaciers in Zagros Mountains, southern Iran.

Salt dome extrusion, S Utah



https://geology.utah.gov/map-pub/survey-notes/geosights/onion-creek-salt-diapir/

Deformation Structures

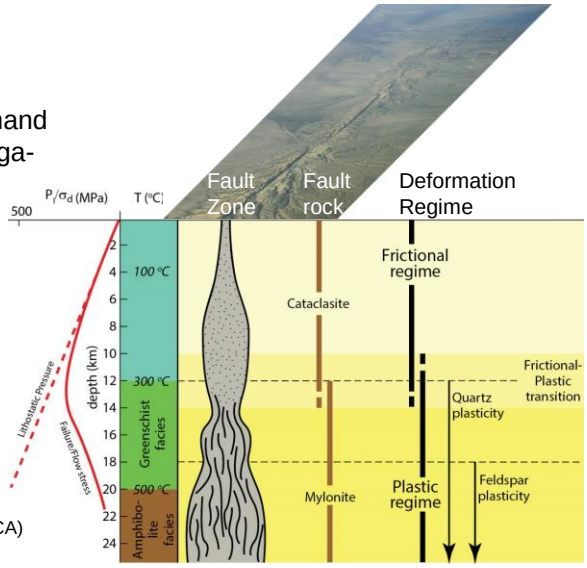


Deformation Regimes

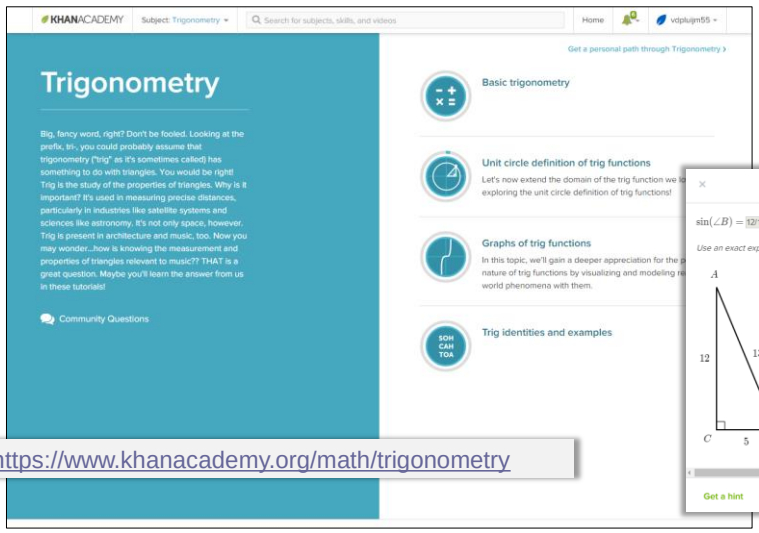
Frictional Regime and **Plastic Regime** are process framework for examination of Earth's deformation structures and tectonics
From micro-scale (microscope) to meso-scale (hand specimen) to macro-scale (mountain belt) to mega-scale (plate).

Synoptic Crustal Fault, by:
- Deformation regime
- Fault rock
- Depth
  - Pressure (P_l; ~27MPa/km)
  - Temperature (T; ~25°C/km)
- Metamorphic Facies
- Rock strength (Differential Stress, σ_d, MPa)

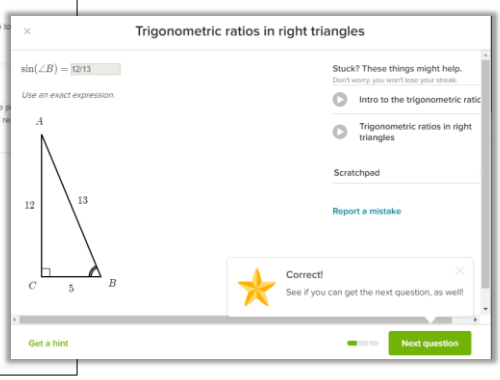
(e.g., San Andreas Fault, CA)



Homework: Trigonometry



https://www.khanacademy.org/math/trigonometry



Commonly used in:
- Force & Stress
- Deformation & Strain
- Labs & Maps