

## Homework 1: Block diagrams.

**Background:** The following lists provide: (1) a summary of the types of rocks and how they form (details to follow in coming weeks!). I expect you will need to look in your text book or a geological dictionary to decide what sort of rocks are meant by the names I've used on the cartoons; (2) a summary of the 'rules' for ordering geological events, some of which have names you will find in your text; and (3) a summary of the types of contacts between rock units and the terms used to describe them.

### Types of rocks:

Igneous, intrusive: formed by solidification of silicate melt below earth's surface. E.g., granite, gabbro, diorite, diabase.

Igneous, extrusive: formed by solidification of silicate melt on earth's surface. E.g., basalt, andesite, rhyolite.

Sedimentary, detrital: Formed by mechanical deposition of mineral and rock clasts that were eroded from pre-existing rocks and transported to their site of deposition. E.g., sandstone, siltstone, mudstone, shale, conglomerate.

Sedimentary, chemical: Formed by chemical precipitation from solution on earth's surface. E.g., limestone, chert, evaporite, iron formation.

Metamorphic, regional: re-crystallization of pre-existing igneous and/or sedimentary rock due to heating associated with burial and deformation deep in the earth. Generally over large scales (10's to 100's of km) and associated with 'foliation' (plastic deformation).

Metamorphic, contact: re-crystallization of pre-existing igneous and/or sedimentary rock due to heating clearly associated with an adjacent intrusive igneous body. Generally over small scales (meters to kilometers) and often not associated with 'foliation'.

### Rules of superposition:

1. (Steno's law): Stratified sequences have a uniform younging or 'facing' direction, with each bed progressively younger in the 'facing' direction. In other words, when a layer of sediment is deposited it has an 'up' and 'down' side; any second sedimentary bed deposited conformably on the 'up' side of the first is younger.
2. ('Original horizontality'): Preserved strata are generally deposited in horizontal sheets, i.e., deposition is sensitive to gravity.
3. ('Truncation rule' or 'cross-cutting relations'): Geometrical truncation of one planar or linear geologic feature by another generally indicates the truncated feature is older.
4. Strata are laterally continuous, until they are thinned to zero thickness or abut the edge of their depositional basin.

5. Intrusions are younger than rocks they intrude; intrusive contacts may form at any angle relative to gravity.
6. Metamorphic foliation may form at any angle relative to gravity.
7. All metamorphism is preceded by an igneous or sedimentary event (i.e., all metamorphic rocks were once igneous or sedimentary rocks).
8. Clasts in detrital sedimentary deposits are of older, pre-existing rocks.

### **Types of contacts:**

Conformable depositional contacts: A change in rock type in a continuously deposited 'package' of sediments (e.g., silt laid down on top of sand, without first tilting or eroding the sand).

Unconformable depositional contacts ('unconformities'): A change in rock type across an erosion surface. I.e., an older, underlying rock type was eroded and a second younger sediment deposited on top of the newly formed surface. There are three kinds of unconformities:

*Disconformity*: Older rocks are stratified and parallel to younger sediments.

*Angular unconformity*: Older rocks are stratified and not parallel to younger sediments.

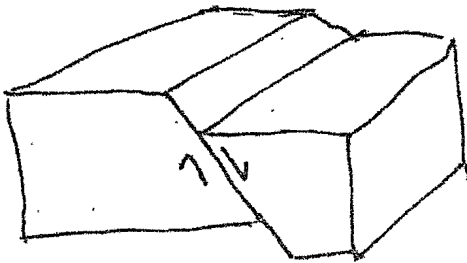
*Non-conformity*: Older rocks are not stratified.

Intrusive: intrusion of magma into pre-existing rock beneath the earth's surface.

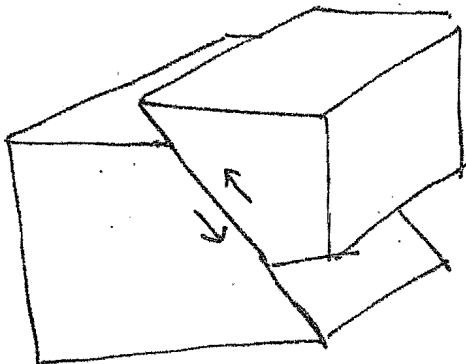
Dislocations (fault): Fracture of pre-existing rock and displacement of the two sides of the fraction with respect to one another. Faults are of three basic types: 'Normal', 'Thrust', and 'Strike-slip'. You will find illustrations explaining their differences in your text. A summary is provided on the next page:

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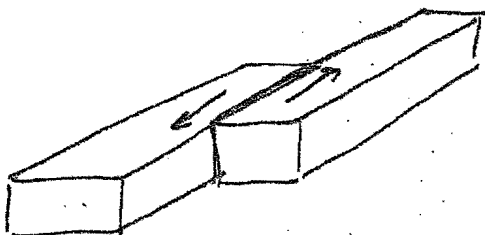
'Normal' (block above fault moves down)



'Thrust'  
(block above fault moves up)



'Strike-slip'  
(little or no vertical motion; lots  
of motion in horizontal)



('Left-lateral' shown)

### **The Assignment:**

(1) Provide an ordered list (from first to last) of geological events that resulted in the structures and geometries of rock types illustrated in the accompanying cartoons. Types of events in each list should include:

- 'Deposition of [name a sedimentary rock]'. Specify type of depositional contact formed.
- 'tilting of [name of rock]'
- 'folding of [name of rock]'
- 'erosion of [name of rock]'
- 'intrusion of [name of intrusive igneous rock] into [name of pre-existing rock]'
- 'extrusion and deposition of [name of extrusive igneous rock]'. Specify type of depositional contact formed, if possible.
- 'faulting of [name of rock]'. Specify type of fault if possible.
- '[contact or regional] metamorphism of [pre-existing rock]'

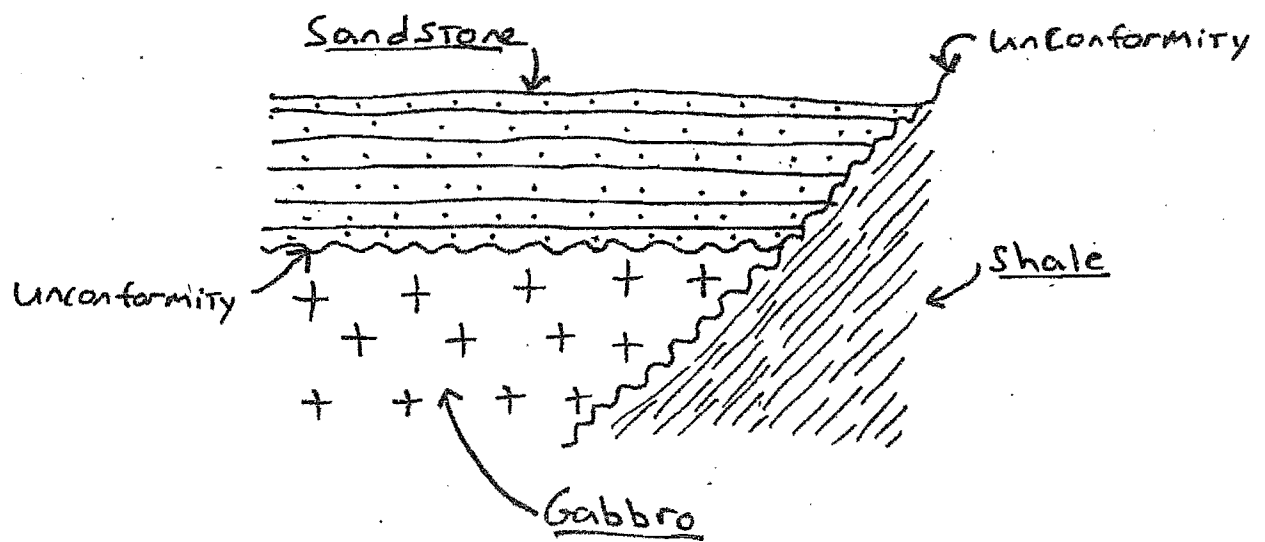
You can use other phrases and terms to describe events, but keep them short and specific, like those above.

(2) Draw three small block diagrams illustrating (complete with labels):

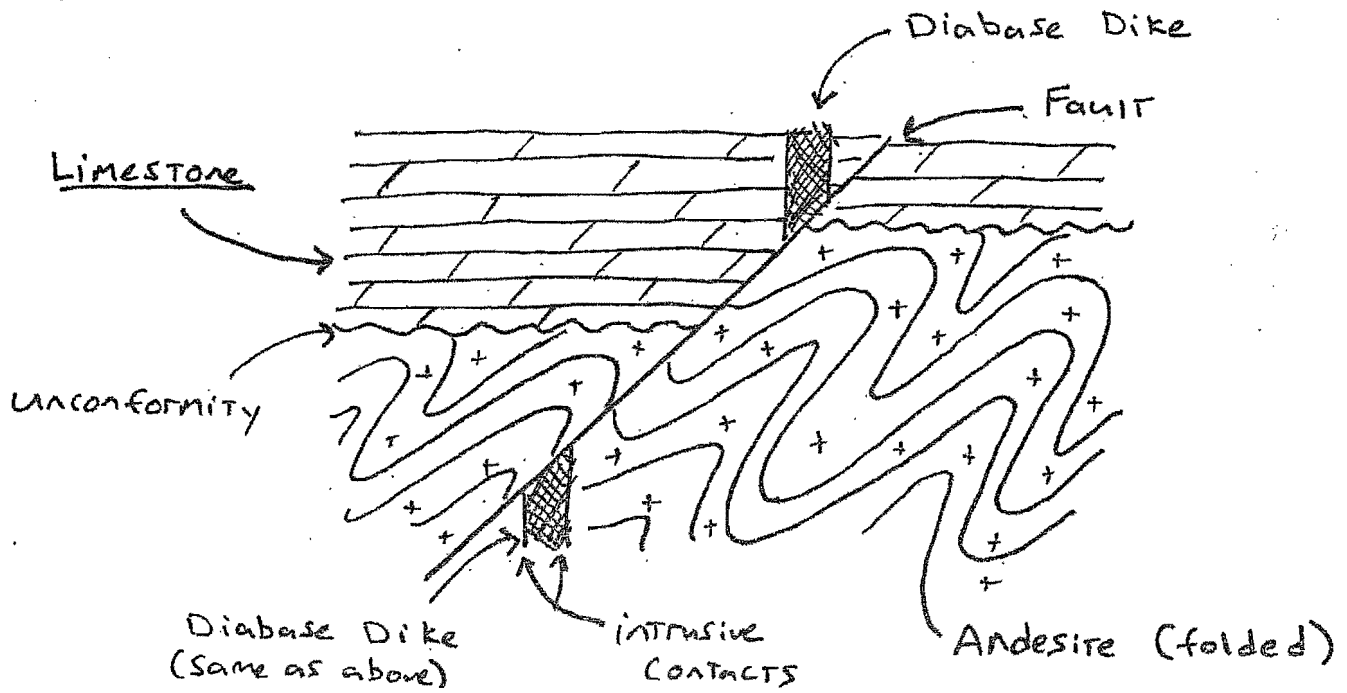
- (a) A normal fault that disrupts a folded package of sedimentary strata
- (b) A thrust fault disrupts a nonconformity, which is itself comprised of sedimentary strata atop the eroded surface of a granite body; finally, a dike (vein of liquid that cross-cuts pre-existing layering) of basalt transects the entire section.
- (c) A body of granite intruded a flat-lying sequence of layered sediments. Then, the entire section was rotated 45° clockwise. Then, the entire package of rocks was eroded. Finally, a sequence of strata of another kind of sedimentary rock was deposited on top of the erosion surface (forming both an angular unconformity where the new strata overly older strata, and a nonconformity where the new strata overly granite).

WITH a TWIST

1.9



1.6 ~~①~~ Break it up



1.c. ~~Block~~ Block diagram.

