EXTREME PANIC!

The First Exam is Only Week Away

Thursday, October 12,

Usual Class Time and Place

REVIEW SESSION

Tuesday, October 10th at 6:00 pm

Room 20, Hasbrouk

Monday is the Columbus Day Holiday

And Tuesday is a UMASS Monday!

Causes of Earthquakes

There are basically three types:-

- VOLCANIC
- **TECTONIC**
- COLLAPSE

(Also man-made due to nuclear explosions)

Tectonic Earthquakes

Most earthquakes occur at plate margins due to tension, compression or shearing forces.

Rocks at plate margins are in constant motion and are being pushed, pulled, bent, twisted and folded.

Inevitably at some point they must break or crack to produce **FAULTS!!**

[Note – some rocks break much more easily than others]

What is a Fault?

- A fault is a break or fracture between two blocks of rocks in response to **stress**.
- **Three** types of stresses produce faults
  1) **Tension**
  2) **Compression**
  3) **Shear**
- One block has moved relative to the other block.
- The surface along which the blocks move is called a **fault plane**.

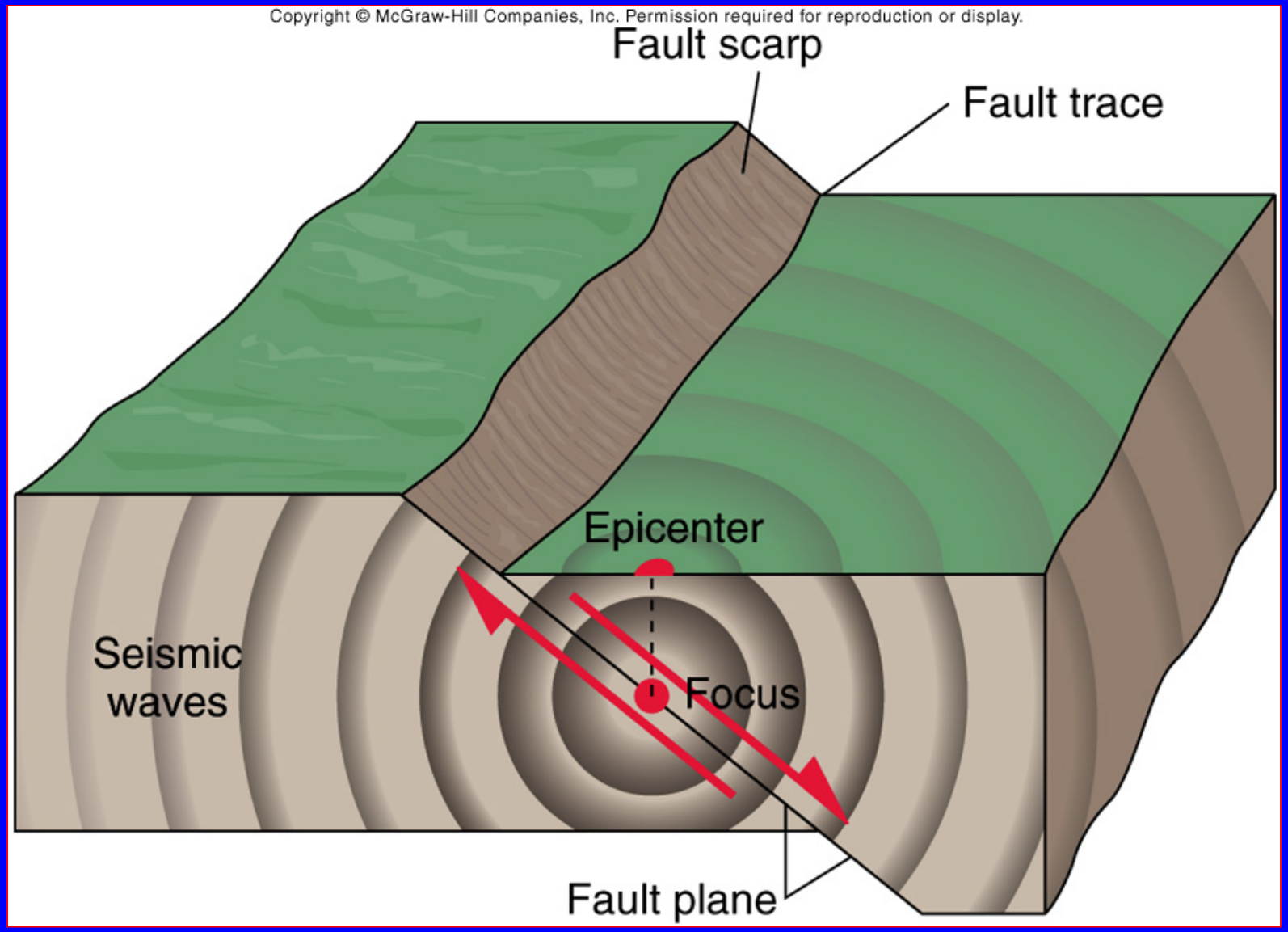
There is a chicken and egg relationship between faults and earthquakes

1) It was initially thought that earthquakes caused faulting (but then what caused the earthquake?)
2) It was later realized that faulting produced the earthquakes.

Thus earthquakes may occur because:-

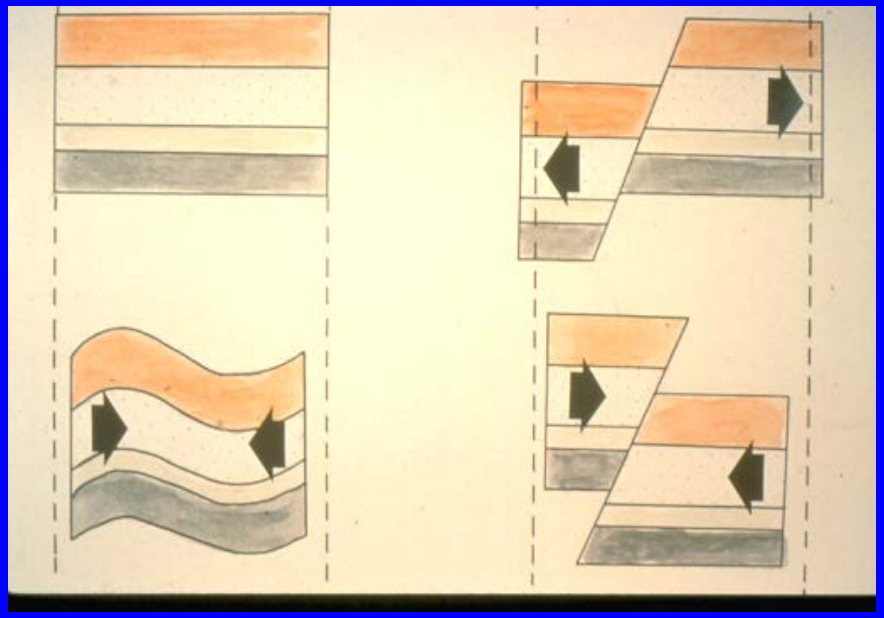
a) Rocks are initially broken to produce a fault.
b) Movement or re-activation of an already existing fault.

[Faults may therefore be thought of as “fossil” relicts of previous earthquakes]



Relationship between faulting and an earthquake

Folding and Faulting

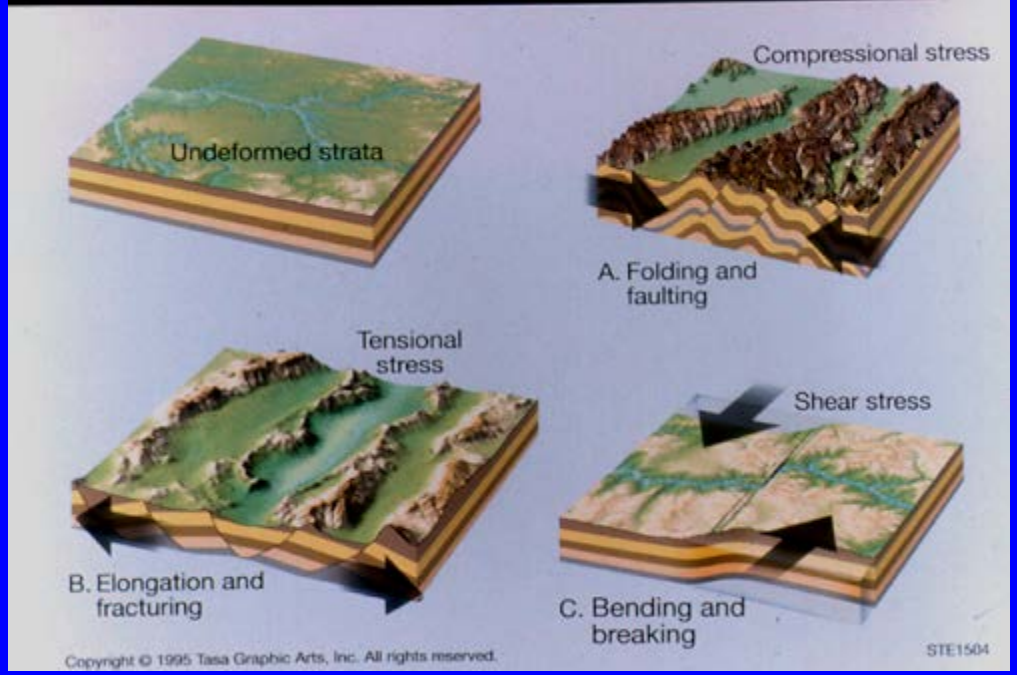


TENSION

COMPRESSION

COMPRESSION – causes rocks to fold and ultimately break to produce a fault.
TENSION – causes rocks to stretch and also break to produce a fault.

Faulting also occurs in response to shearing stresses

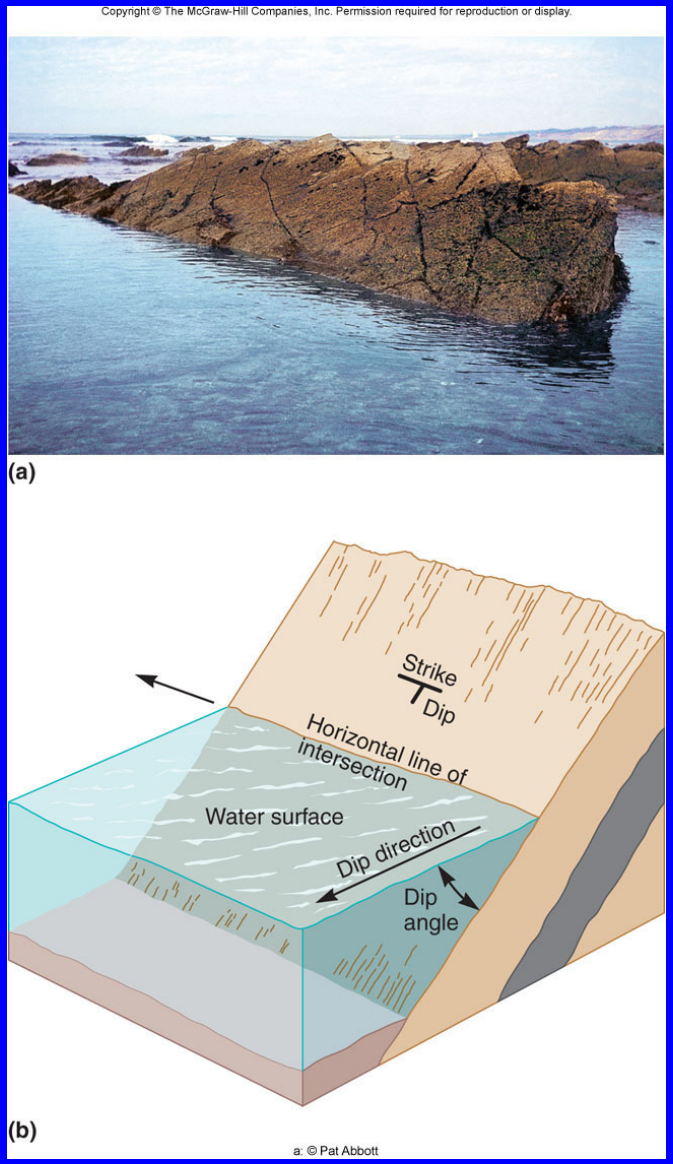


Relationship of stresses to types of faulting

Example of folded rocks that have broken to produce a fault

Some basic terminology

(Page 147 in book)



STRIKE – a horizontal line along the direction of a fault plane.

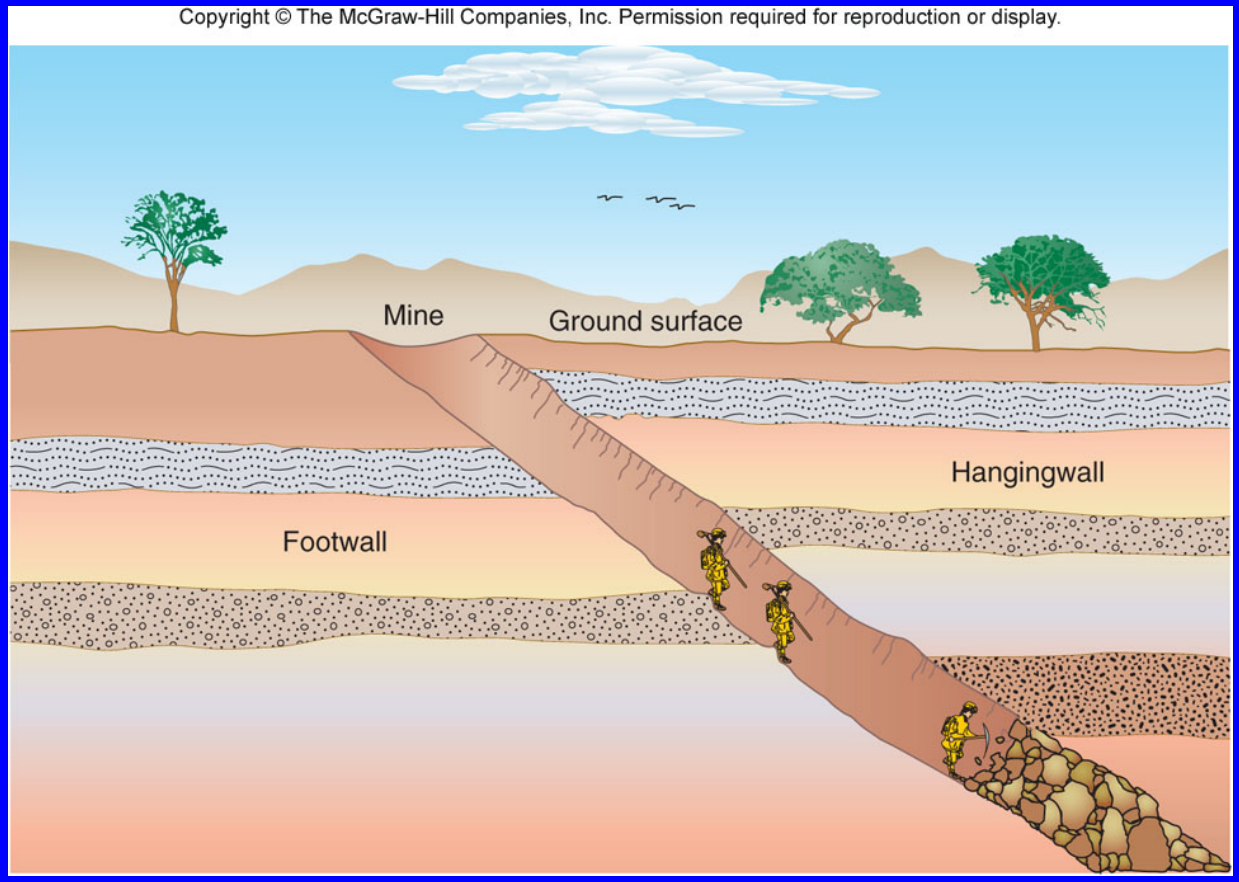
DIP – the angle between the fault plane and the horizontal.

More terminology

Page 148 in book

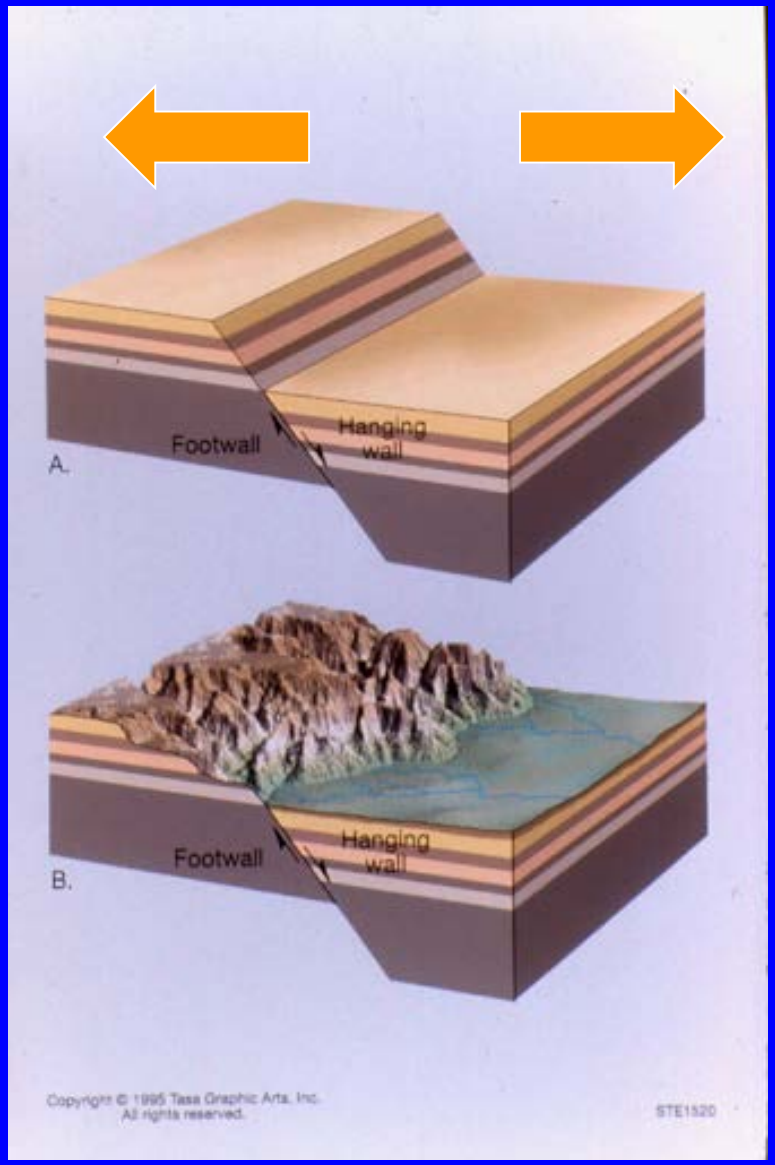
Hanging wall - is the block above the fault plane.

Foot wall - is the block below the fault plane.



Terminology comes from mining

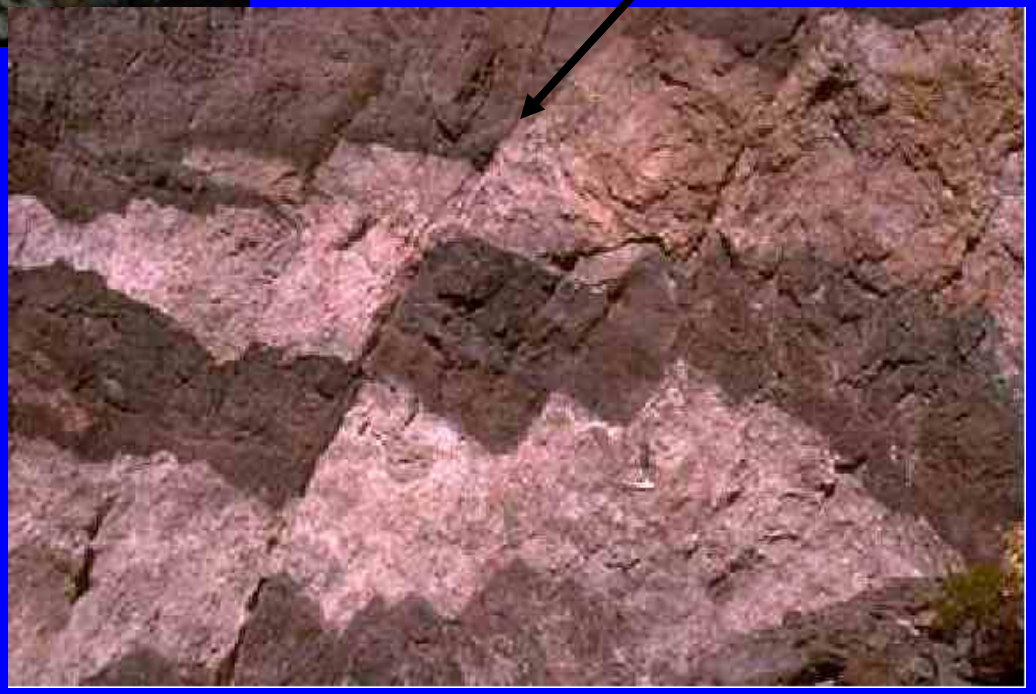
Normal Faults



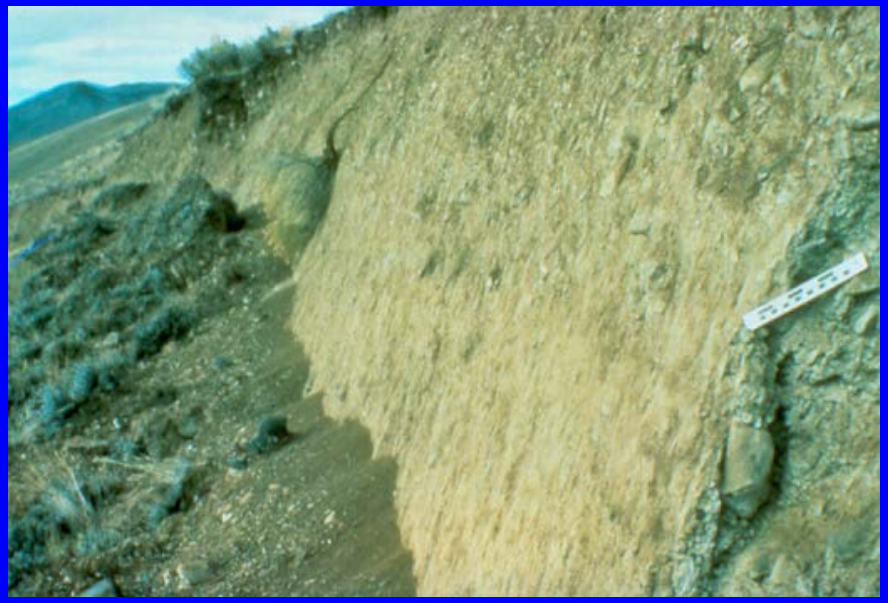
- Normal faults are produced by **tensional forces**.
- The upper block (hanging wall) moves **down** relative to the lower block (foot wall).

Two examples of normal faults

Fault plane

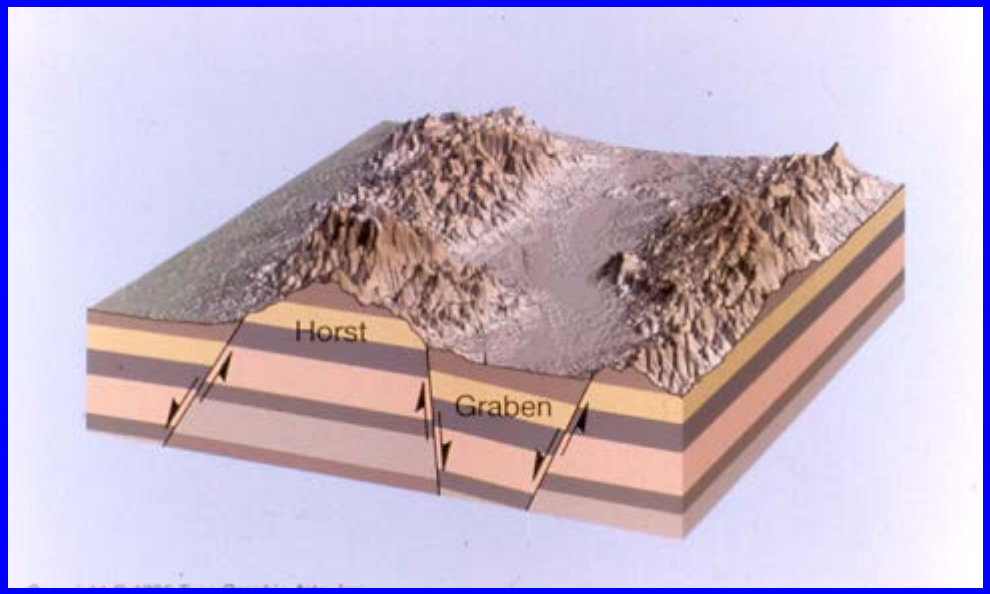


Fault plane



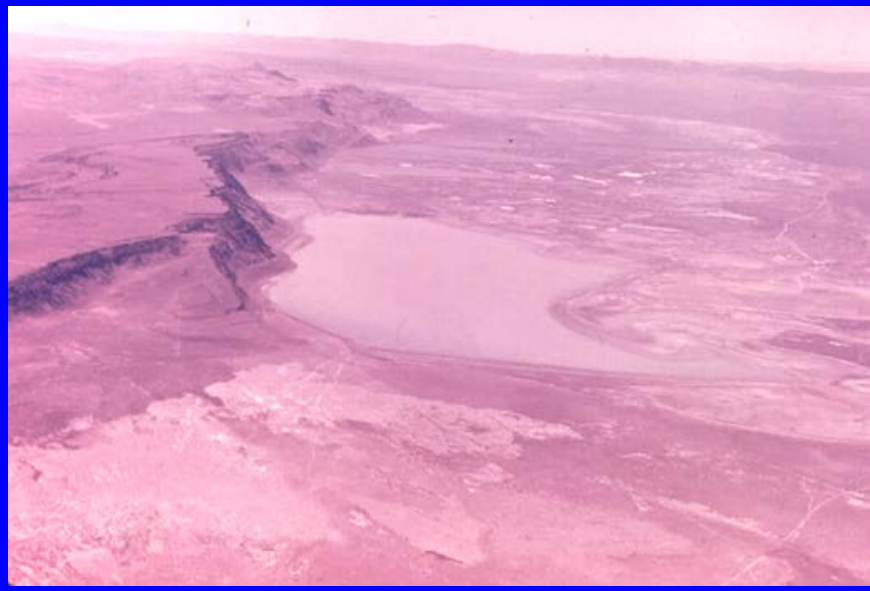
Two scarps produced by normal faulting.

Horsts and Grabens

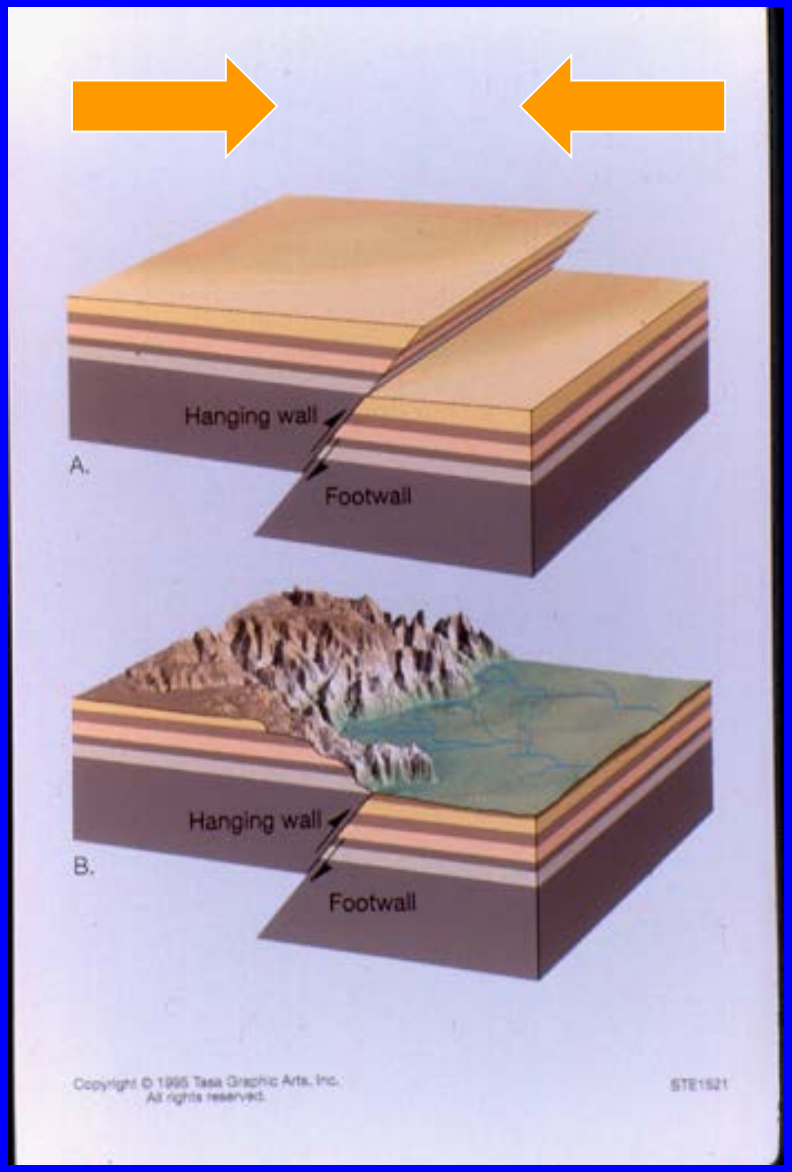


A series of parallel normal faults produce Horsts (hill) and Grabens (valley).

GRABEN - valley formed as one block drops down.
HORST - hill formed as the other block moves up.



Reverse Faults



- Reverse faults are produced by **compressive** forces.
- The upper block (hanging wall) **moves up** relative to the lower block (foot wall).

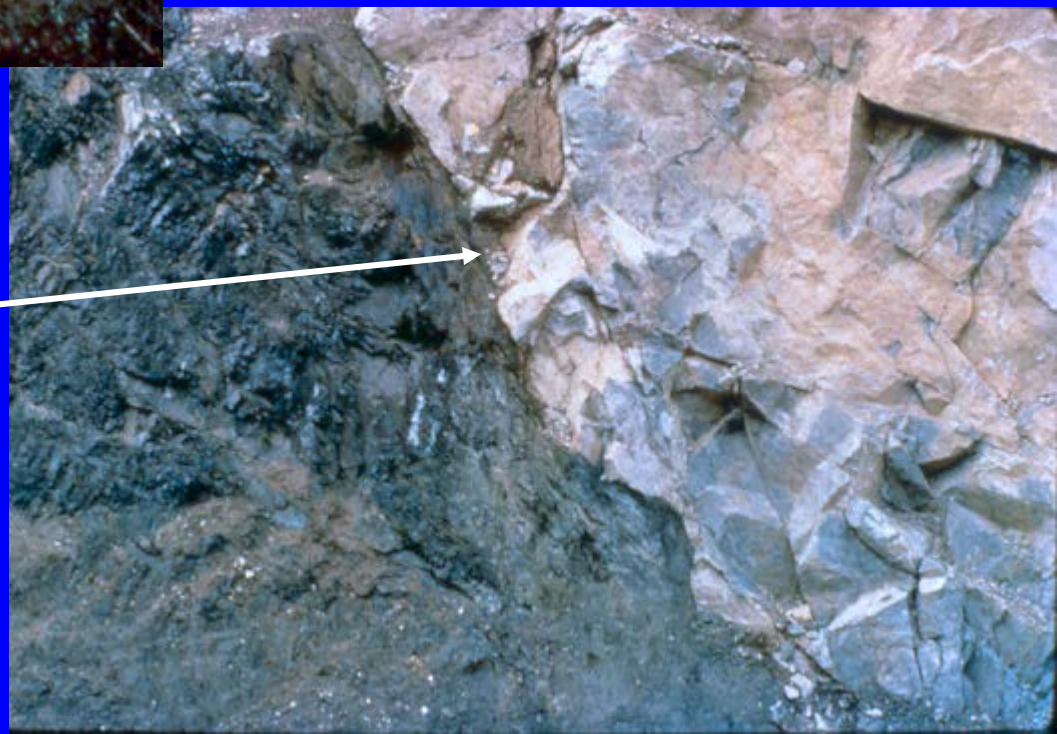
Small reverse fault associated with folded rocks

Fault plane

Another small reverse fault

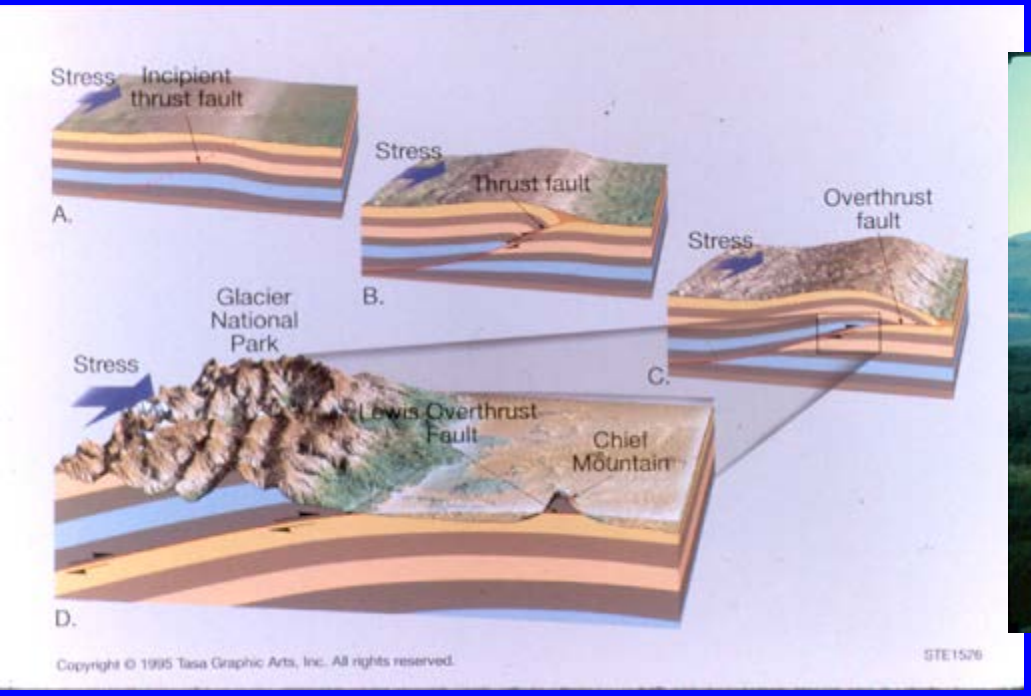
A larger reverse fault

Close-up of a reverse fault plane.



Note the two completely different rock-types.

Thrust Faults

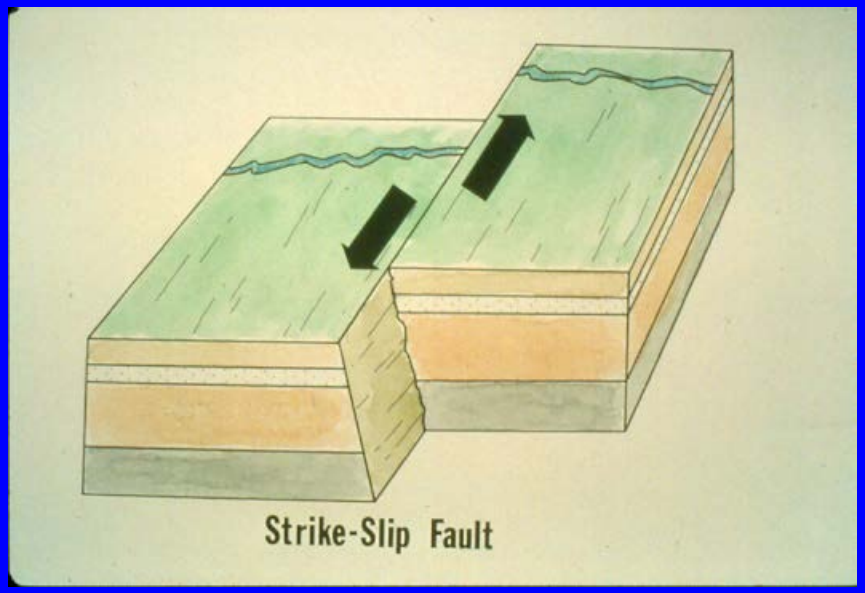


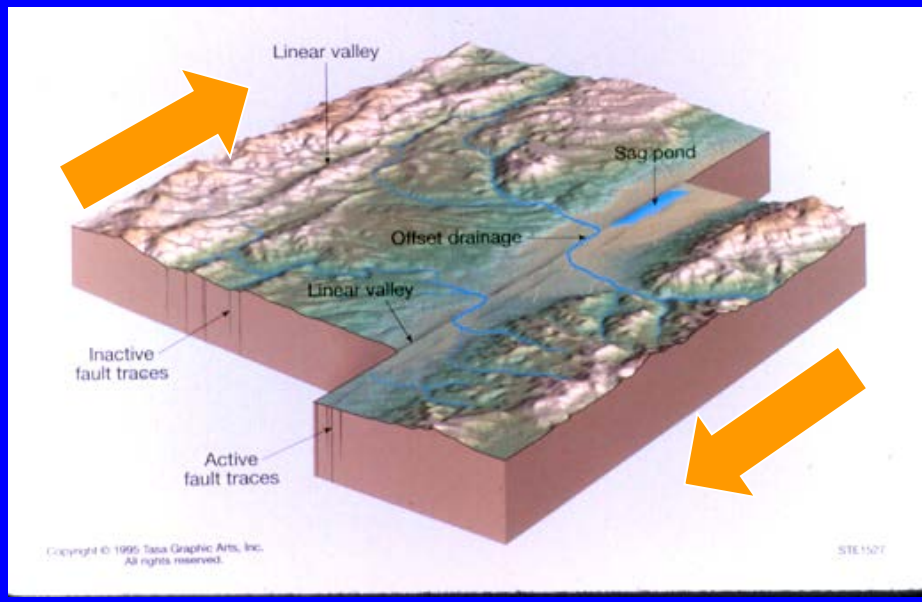
A **thrust** (or overthrust) fault is a low-angle reverse fault, again resulting from **compressive** forces. Thrust faults are very common in highly folded mountain belts (the example is from Glacier National Park) associated with continental collision.

A thrust fault may look a bit like an unconformity in that completely different rocks are separated by a plane surface. With a thrust fault, however, the **older rocks** have been pushed up on top!

Transform Faults

(Strike-Slip Faults)





Transform faults move **horizontally** in response to **shearing** stresses.
They are also called **strike-slip faults** because the movement is along strike.

Strike-slip fault in a lettuce field

Two examples of strike-slip movement along transform faults (note lack of vertical movement).

Transform Faults

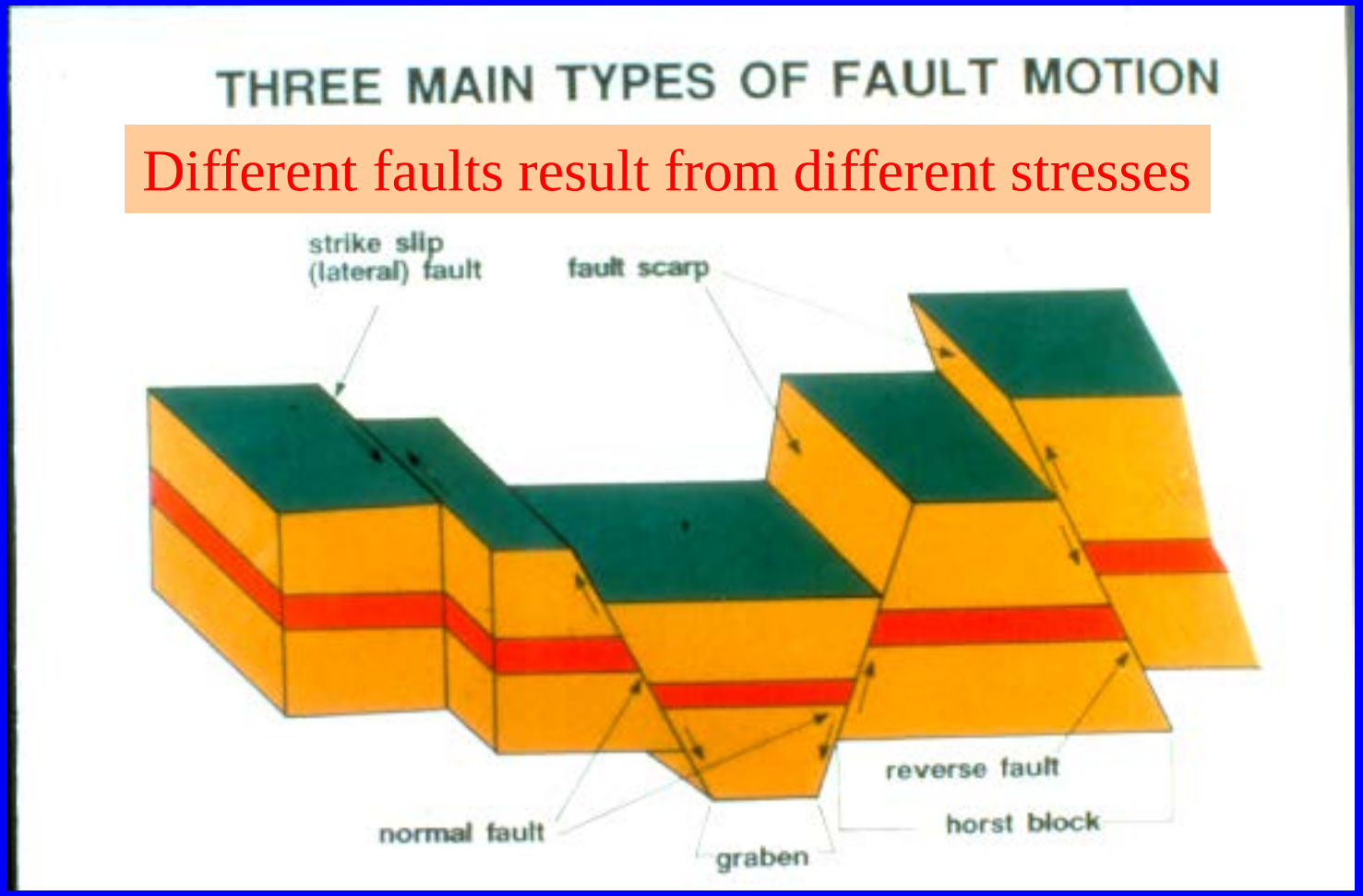
An example in a field of lettuce.

An aerial view of a much larger example.

The San Andreas Fault

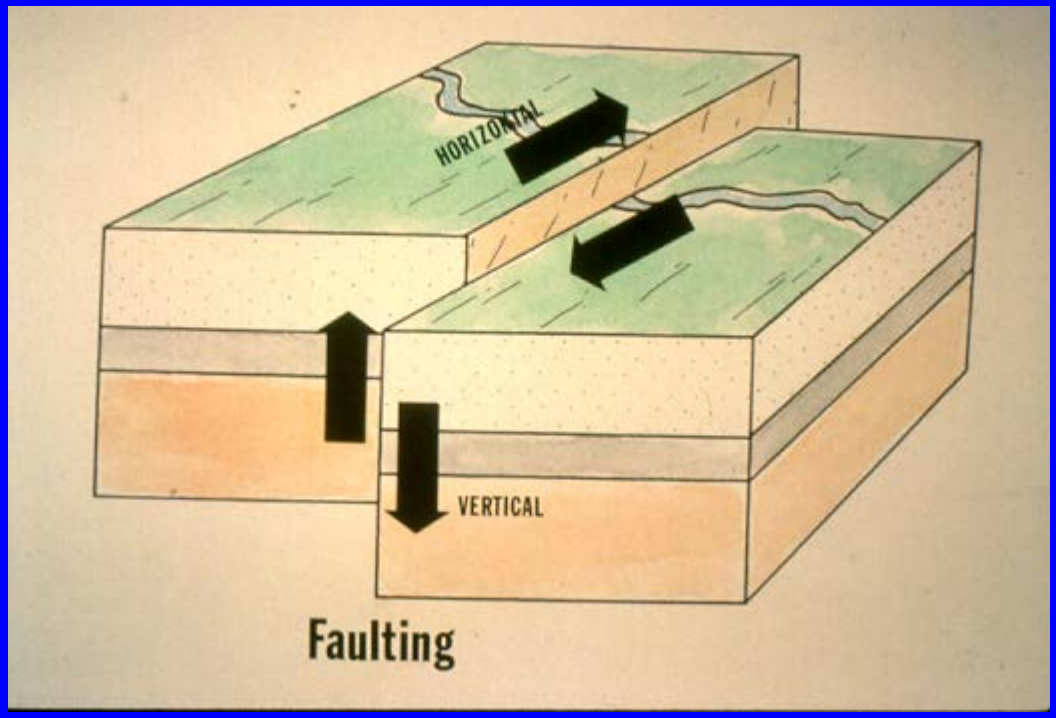
A very large example of a transform fault involving over 200 km of offset.

Summary of Fault Movements



Why is it unlikely that one would find all these faults in the same place?

More Complex Examples



In this example there has been **BOTH** horizontal and vertical movement along the fault plane.

In these two examples there has been both horizontal and vertical movement along the fault plane.