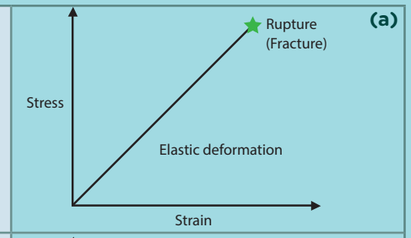
Topics F2: Key idea 3 and G2: Key idea 1 – Rock deformation and structures

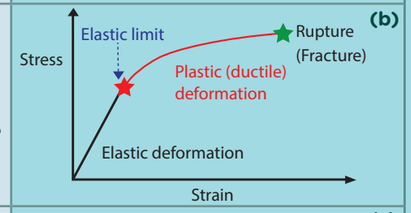
Rock deformation

- Rocks **strain** when subjected to **stress** (Hooke's law).
- They show elastic/brittle and ductile/plastic behaviour.
- Permanent strain and eventual fracturing occurs when the elastic limit is exceeded on a stress-strain curve.
- Deformation is a function of the competence of the parent rock and conditions during deformation (temperature, confining pressure, strain rate).

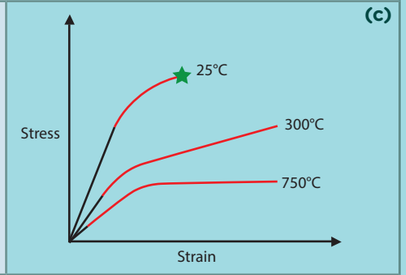
Competent behaviour
- Brittle fracture
- Little ductile deformation
- Typical limestone
- Dry rocks
- Results in faults and joints



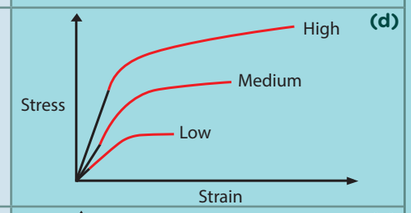
Incompetent behaviour
- Ductile deformation
- Wet rocks
- Typical of shale and mudstone
- Results in fold structures



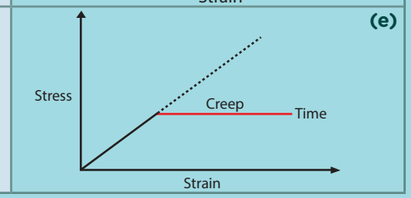
Effect of temperature
- Related to depth of burial - strength decreases with the temperature
- Higher temperature - more ductile resulting in folds
- Lower temperature - more brittle fracture resulting in faults



Effects of confining pressure
- The deeper the burial the higher the confining pressure
- Higher confining pressure the stronger the rock - more ductile



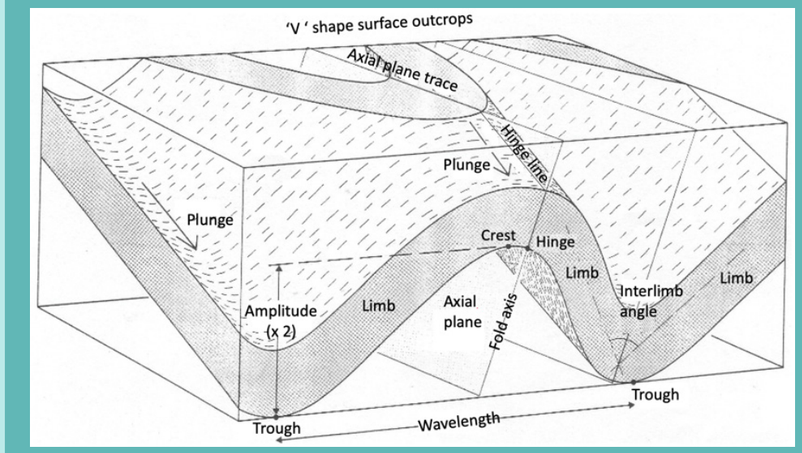
Effect of time
- Rock deforms elastically unless stressed for a length of time (millions of years)
- With time the rock deforms by ductile flow - creep



Folding: key elements and characteristics

Folding occurs when compressional stresses exceed the yield strength of a rock. Different types of fold include:

- hinge, limb, interlimb angle (open tight isoclinal)
- axis, axial plane/trace, axial plane attitude (upright, inclined, overturned, recumbent)
- amplitude ($\frac{1}{2}$ fold height), wavelength
- antiform/synform (upfold/downfold)
- anticline/syncline (oldest rocks in the core/ youngest rocks in the core)
- plunge - dip of fold axis (antiform – closes in direction of plunge, synform opposite direction)
- fold symmetry (a function of limb length), symmetric/asymmetric – equal/unequal limbs.



Unconformities

Unconformities result from tectonic movements, erosion and sea level changes that form a break in the geological record between the deposition and deformation of two sets of strata.

Faulting: key elements and characteristics

Faulting occurs when compressional, tensional or shear stresses exceed the fracture strength of a rock.

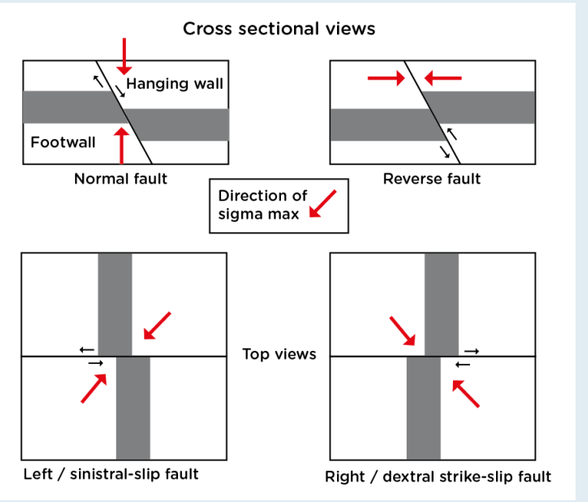
Fault types are determined by the orientation of the principal stresses (σ max, σ int, σ min).

Dip-slip faults

- **Normal** (hanging wall moves down relative to the footwall)
- **Reverse** (hanging wall moves up relative to the footwall)
- **Thrust** (low angle reverse fault: <45°)

Strike-slip faults

- Left/ sinistral, right/dextral



Fault plane elements

- Displacement – net slip along fault plane
- Throw – vertical displacement of a bed
- Fault gouge, fault breccia
- Slickensides – scratches on fault surface