PRIMARY AND SECONDARY STRUCTURES

- Primary are those which develop at the time of formation of the rocks (for example sedimentary beds).

- Secondary structures are those that develop in rocks after their formation as a result of their subjection to external forces (for example brittle fractures).

*Figure F15.* Extension fractures in mudstone and siltstone of the Passaic Formation (Brunswick Middle Red zone) exposed in vertical face cuts during excavation of a commercial pipeline, Somerset County. Plastic netting on the upper benches is about 4 feet in height. Note the difference in thickness between bedding and fractured layers and how fracture density and dimensions differ. Photograph courtesy of Don Monteverde, NJGS.
PRIMARY GEOLOGICAL STRUCTURES

• Sedimentary bedding and features (like fossils)

• Crystalline (igneous and metamorphic) compositional layering

• Mineral foliation in crystalline rocks
FOLDS; ANTICLINES AND SYNCLINES

are fold structures in rock layers in which the oldest rocks occur, respectively, in the center, or on the flanks of the fold.

- They can be identified by their strikes and dips.

Canadian Rockies, British Columbia

Eroded anticlines and synclines

Calico Mountains, SE California
ROCK CLEAVAGE in structural geology describes a type of planar rock feature that develops as a result of deformation and metamorphism.

- **Slaty cleavage** results from low-grade metamorphic recrystallization of mud and silt into platy minerals like chlorite at the microscopic scale.
SPACED
CLEAVAGE
SPACED CLEAVAGE

results from low-grade metamorphic pressure solution, removal of soluble material, and the accumulation of residual insoluble material along cleavage selvages or stylolites.
SPACED CLEAVAGE within coarser-grained clastics and carbonates results from fluid loss, mineral dissolution, and accumulation of insoluble material along cleavage planes.
CRENULATION CLEAVAGE is used to describe second or multiple, overlapping cleavage sets.
BRITTLE ROCK FRACTURES

• Joints are fractures along which any movement which may have occurred is perpendicular to the fracture surface.

• Joints, the commonest structures, form in response to compression, tension, and shearing.

• Faults are fractures along which the opposite sides have moved relative to one another and parallel to the fracture surface.
MINERALIZED FRACTURES (OR VEINS)