# KABUK DEFORMASYONU

**Figure 22.16** This image shows the entire Valles Marineris canyon system, over 5000 kilometers long and up to 8 kilometers deep. The dark red spots on the left edge of the image are huge volcanoes, each about 25 kilometers high. (Courtesy of U.S. Geological Survey)

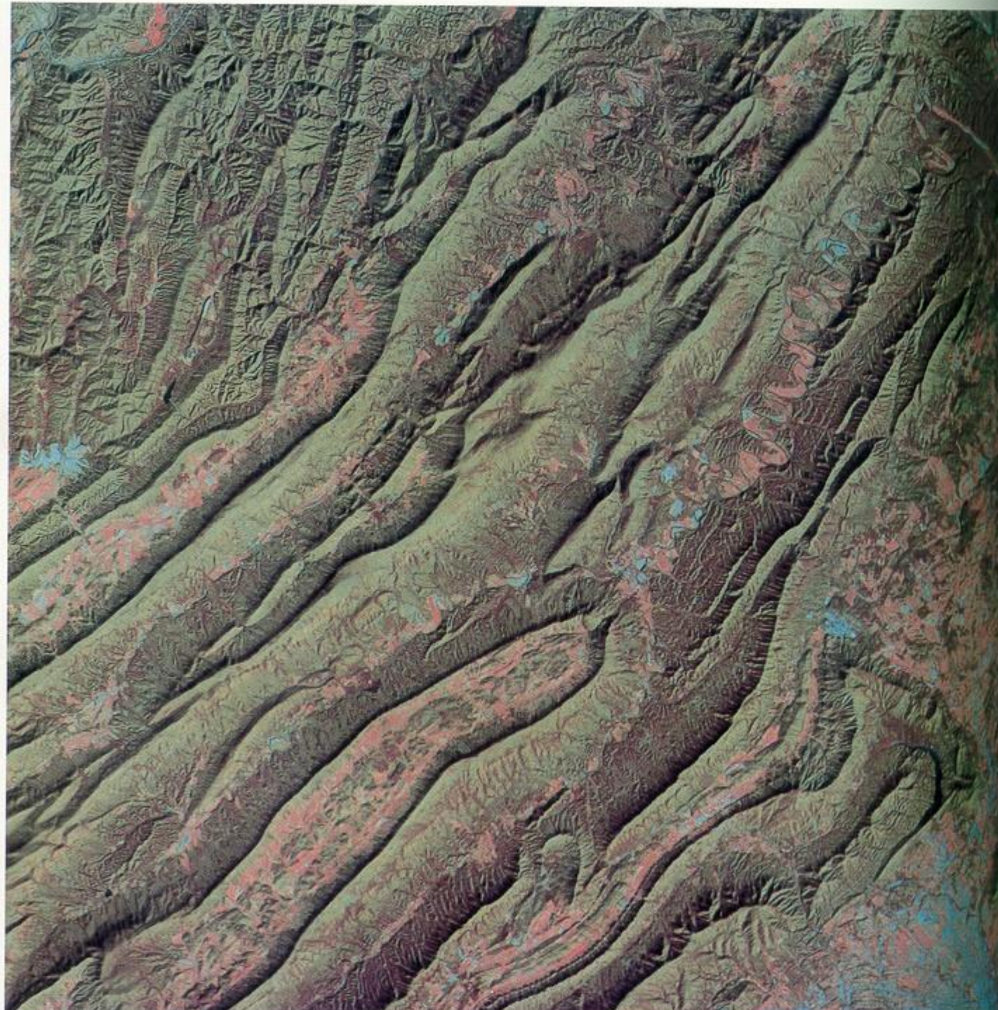


**Figure 20.3**
**Folded rocks of a mountain belt** can be seen in this space photograph of the southern part of the Appalachian Mountains.

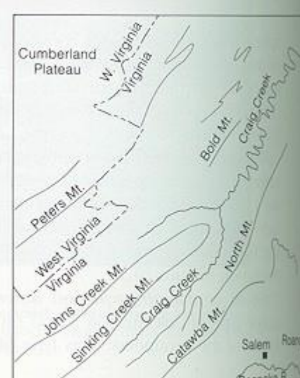


**Figure 15.1** Uplifted and folded sedimentary strata at Stair Hole, near Lulworth, Dorset, England. These layers of Jurassic-age rock, originally deposited in horizontal beds, have been folded as a result of the collision between the African and European crustal plates. (Photo by Tom Bean)

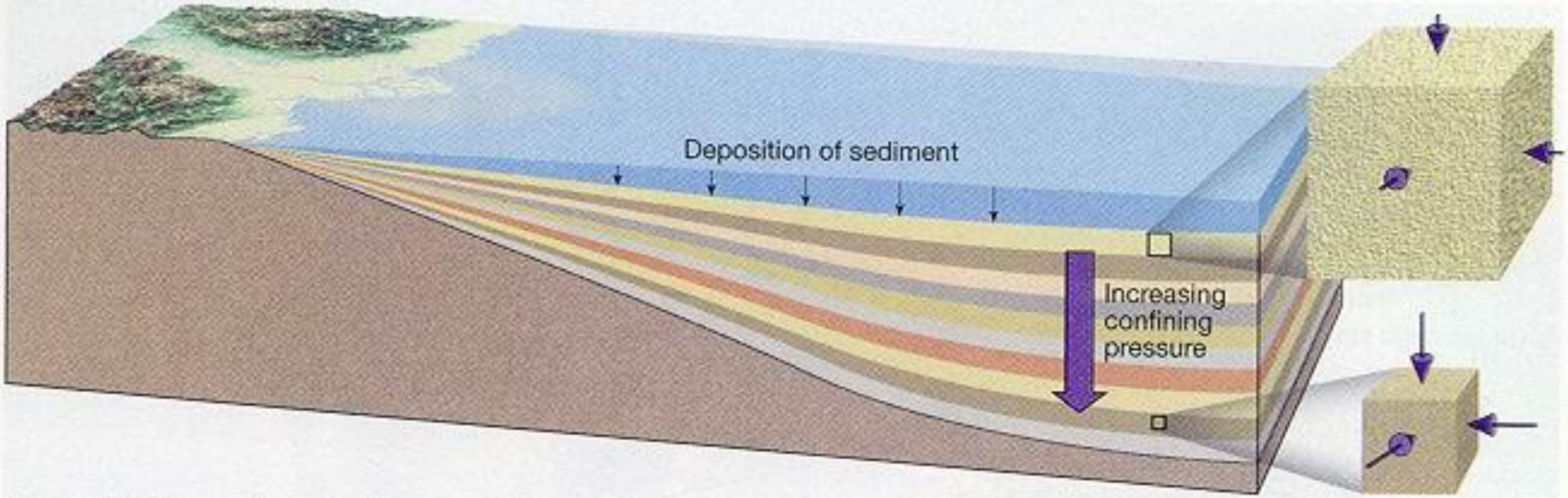



**Figure 15.2** In a sedimentary basin, older layers at depth are subjected to increased confining pressures as additional layers are deposited. The higher pressures result in fluid expulsion and pore closure, causing a reduction in volume.

**Figure 15.3** Rocks exhibiting the results of ductile behavio These rocks were deformed at great depth and were subsequently exposed at the bottom of the Grand Canyon. (Photo by E. J. Tarbuck)

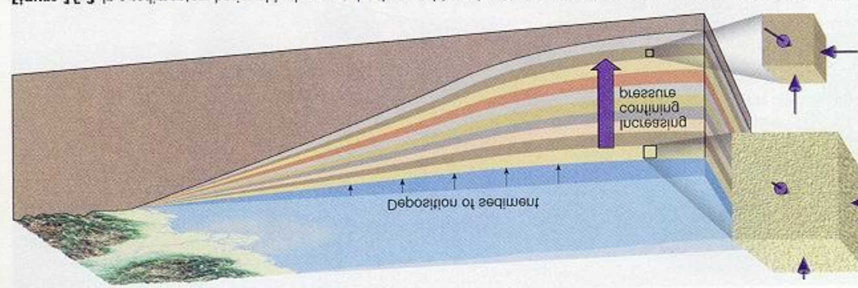



**Figure 15.2** In a sedimentary basin, older layers at depth are subjected to increased confining pressures as additional layers are deposited. The higher pressures result in fluid expulsion and pore closure, causing a reduction in volume.

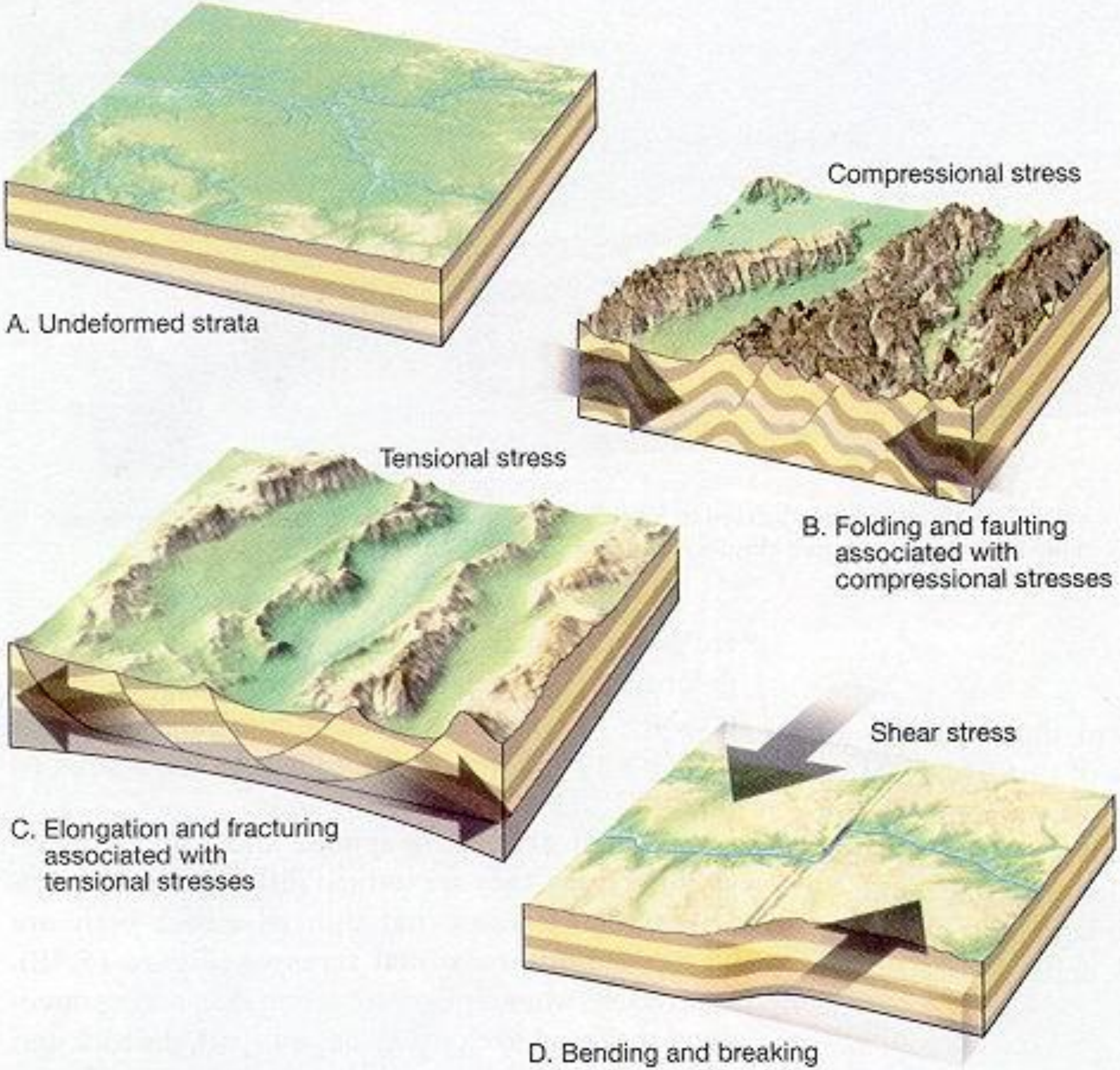



**Figure 15.4** Simplified diagrams showing the deformation of **A.** flat-lying strata. **B.** Compressional stresses tend to shorten a rock body, often by folding. **C.** Tensional stresses act to elongate, or pull apart a rock unit. **D.** Shear stress acts to displace rocks by bending and breaking them.

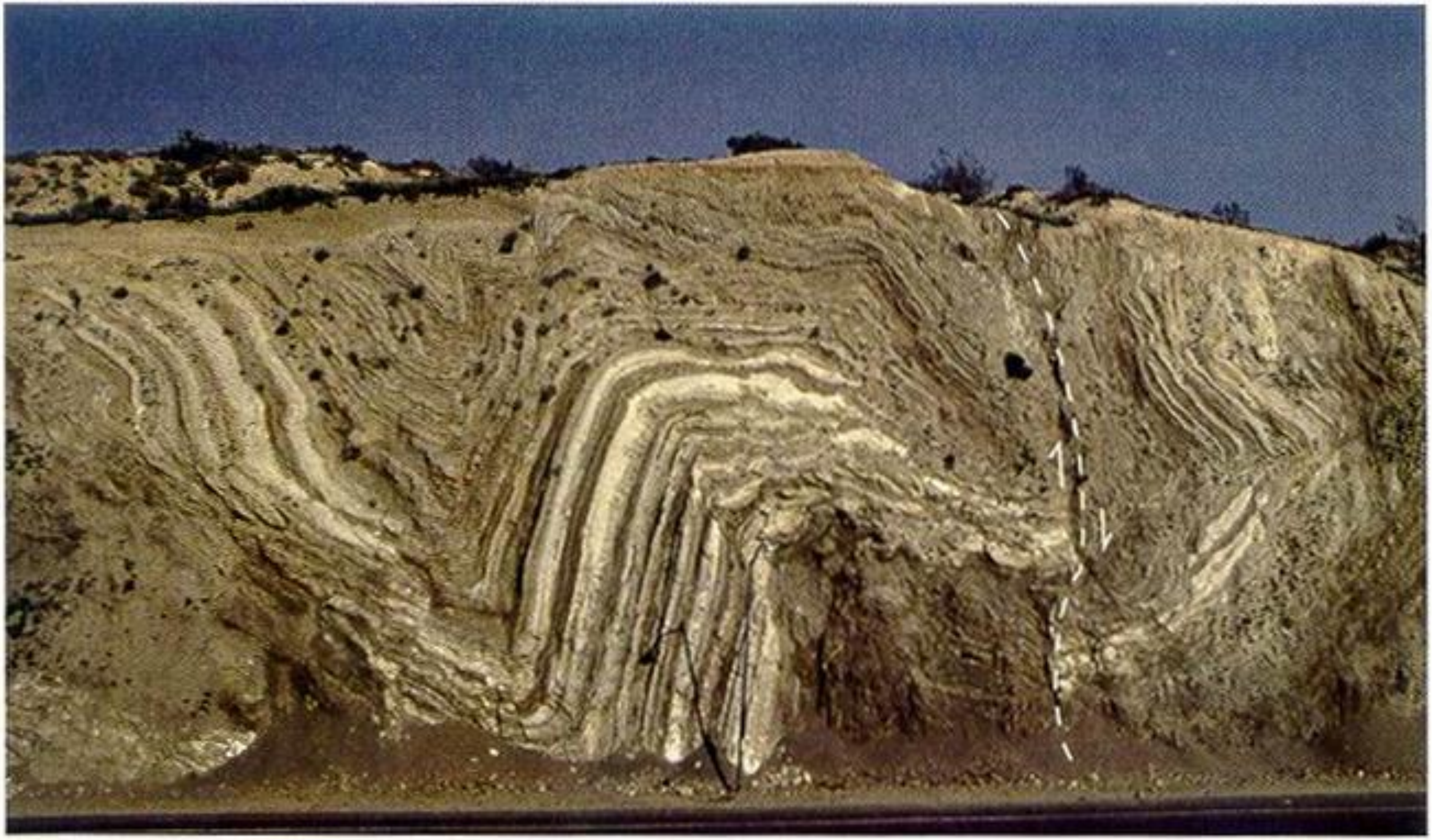


**Figure 15.5** Deformed sedimentary strata exposed in a road cut near Palmdale, California. In addition to the obvious folding, light-colored beds are offset along a fault located on the right side of the photograph. (Photo by E. J. Tarbuck)


**Figure 15.6** A marble cylinder deformed in the laboratory by applying thousands of pounds of load from above. Each sample was deformed in an environment that duplicated the confining pressure found at various depths. Notice that when the confining pressure was low, the sample deformed by brittle fracture, whereas when the confining pressure was high, the sample deformed plastically. (Photo courtesy of M.S. Paterson, Australian National University)

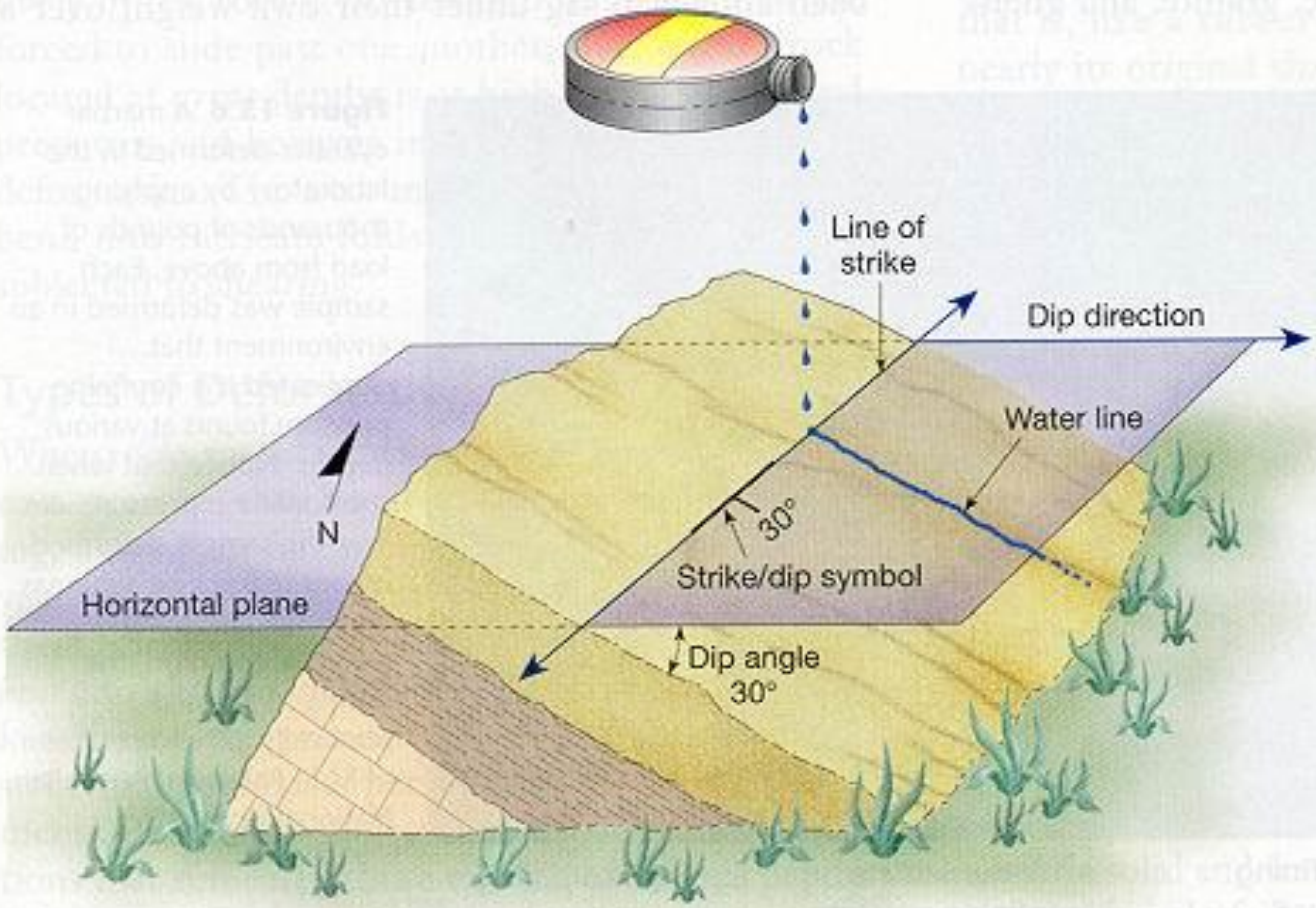



**Figure 15.7** Strike and dip of a rock layer.

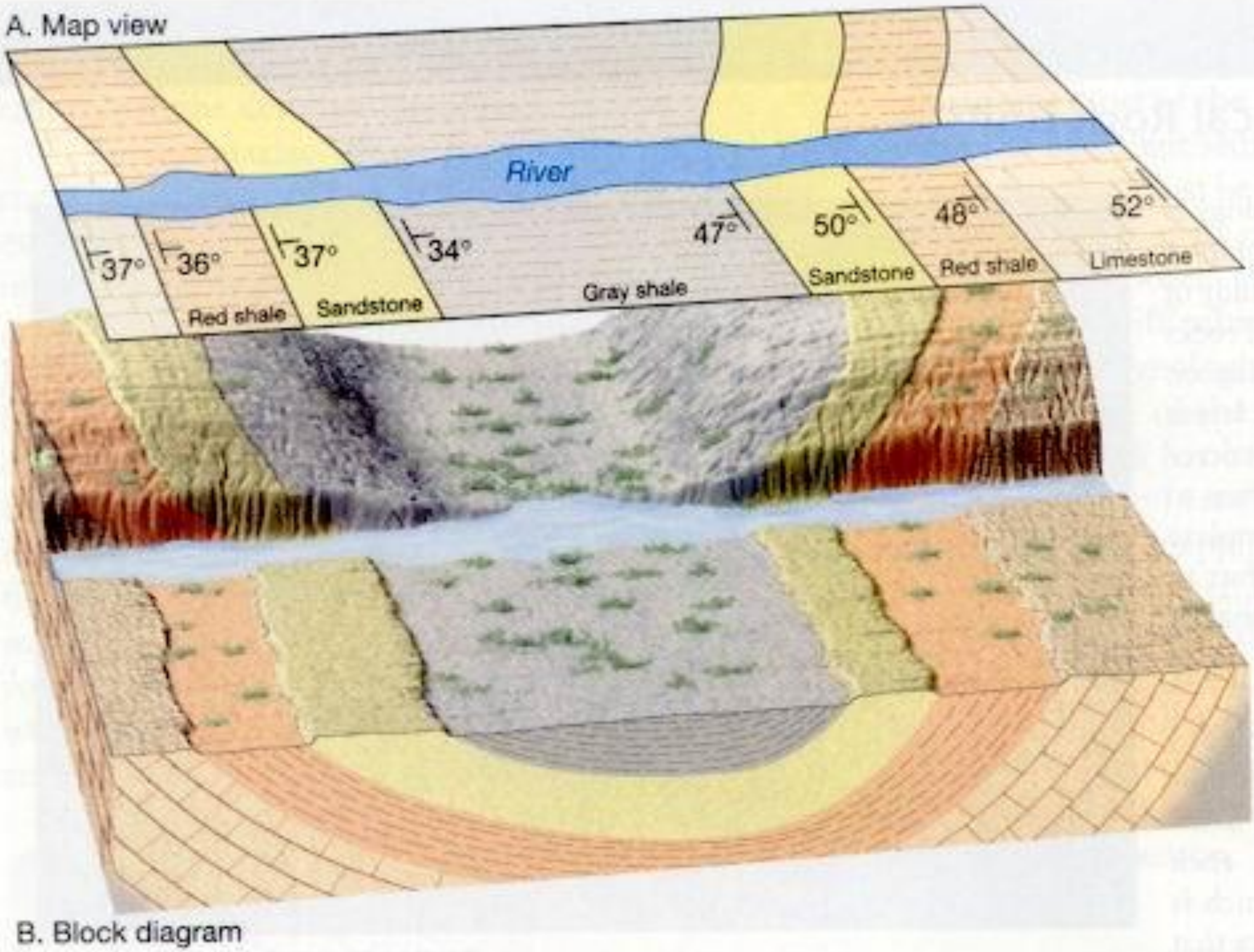



**Figure 15.8** By establishing the strike and dip of outcropping sedimentary beds on a map **A.**, geologists can infer the orientation of the structure below ground **B.**

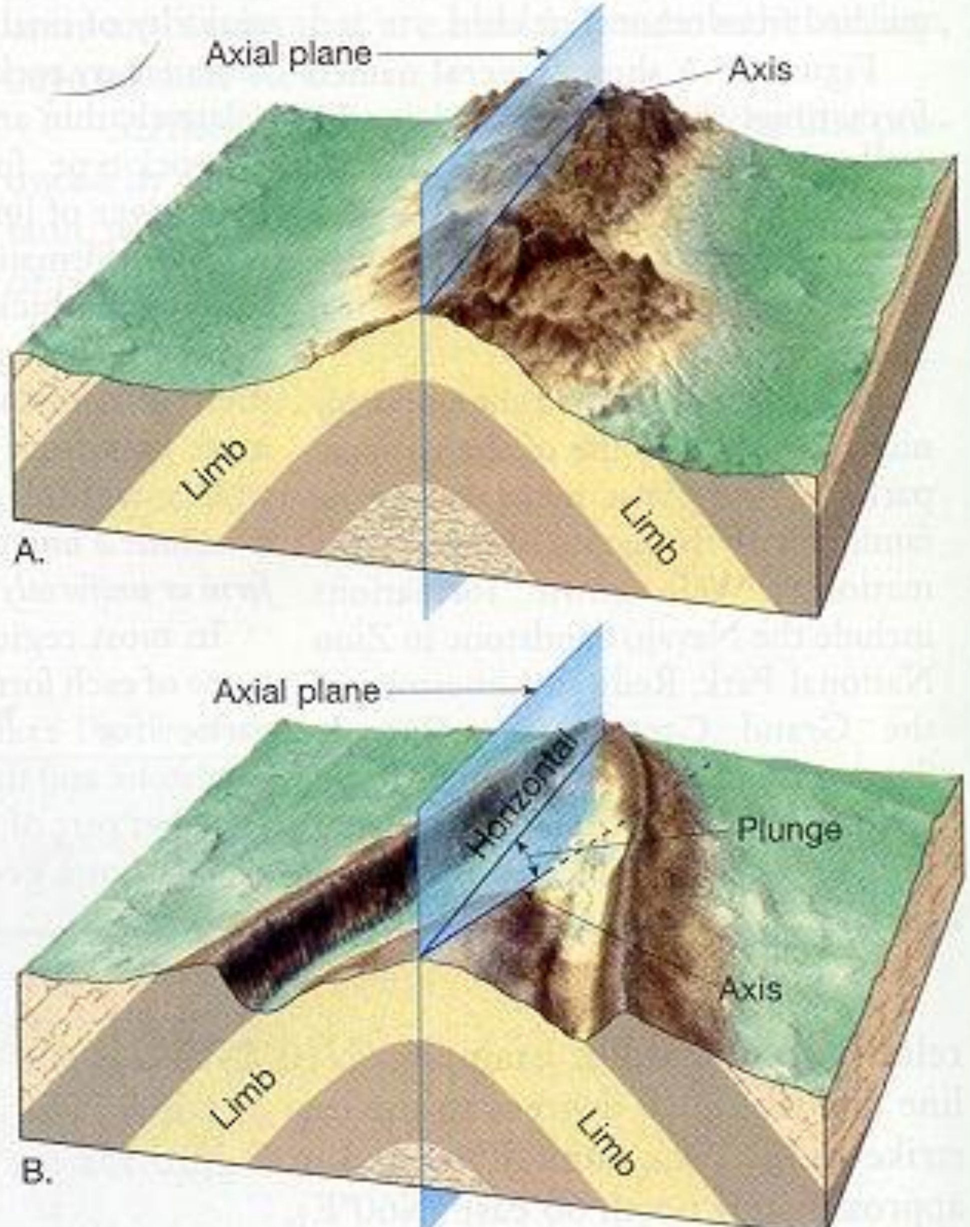



**Figure 15.9** Idealized sketches illustrating the features associated with symmetrical folds. The axis of the fold in A is horizontal, whereas the axis of the fold in B is plunging.

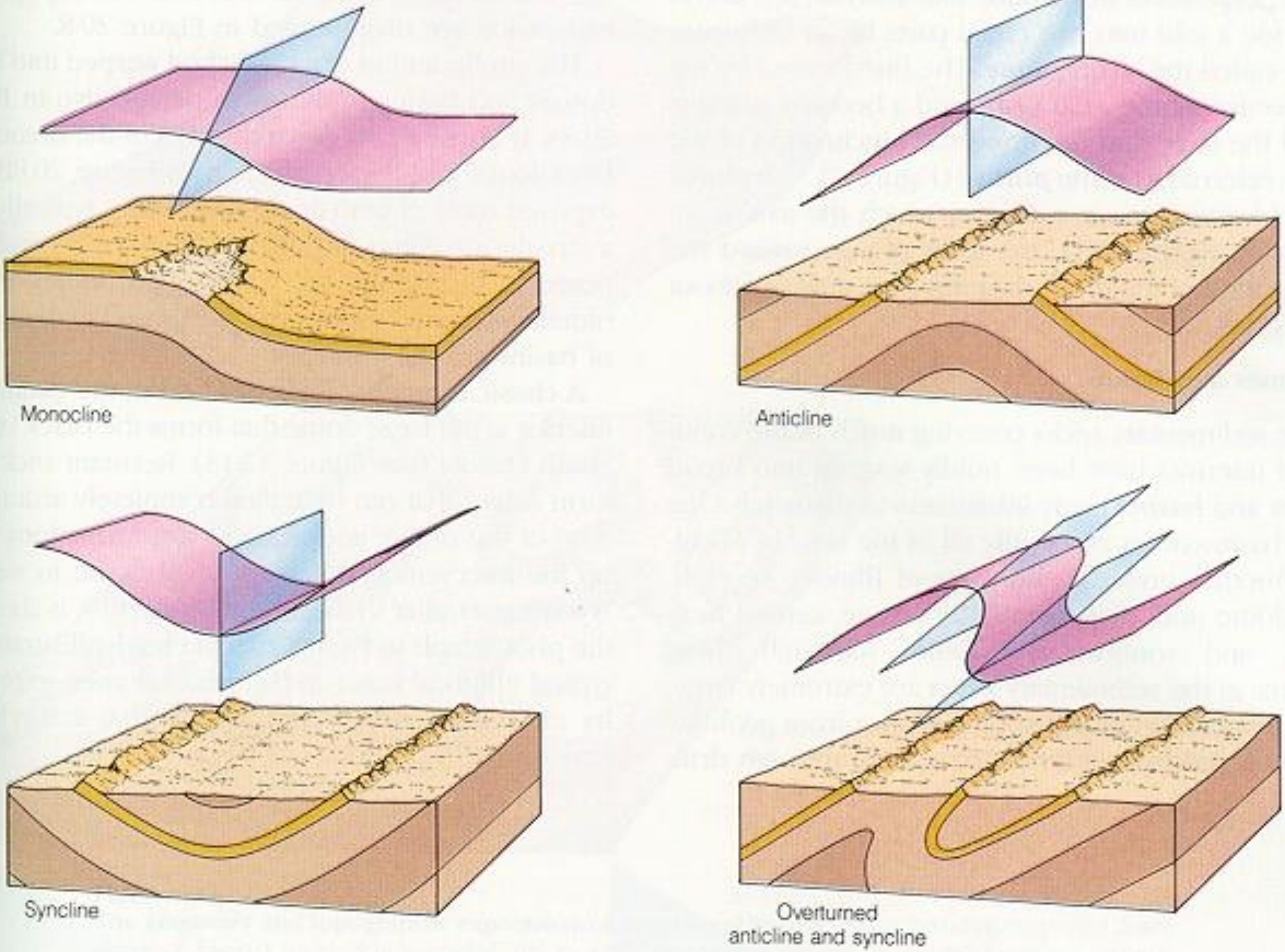



**Figure 20.6**
**The nomenclature of folds** is based on the three-dimensional geometry of the structure, although most exposures show only a cross section or map view.

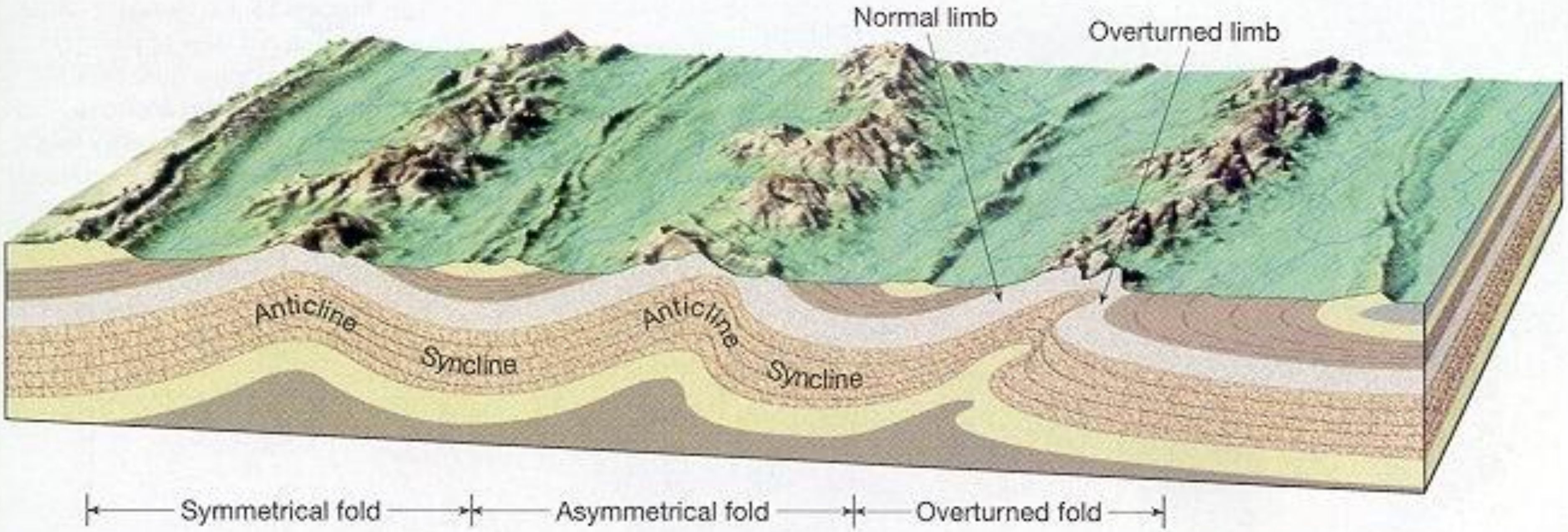



**Figure 15.10** Block diagram of principal types of folded strata. The upfolded or arched structures are anticlines. The downfolds or troughs are synclines. Notice that the limb of an anticline is also the limb of the adjacent syncline.

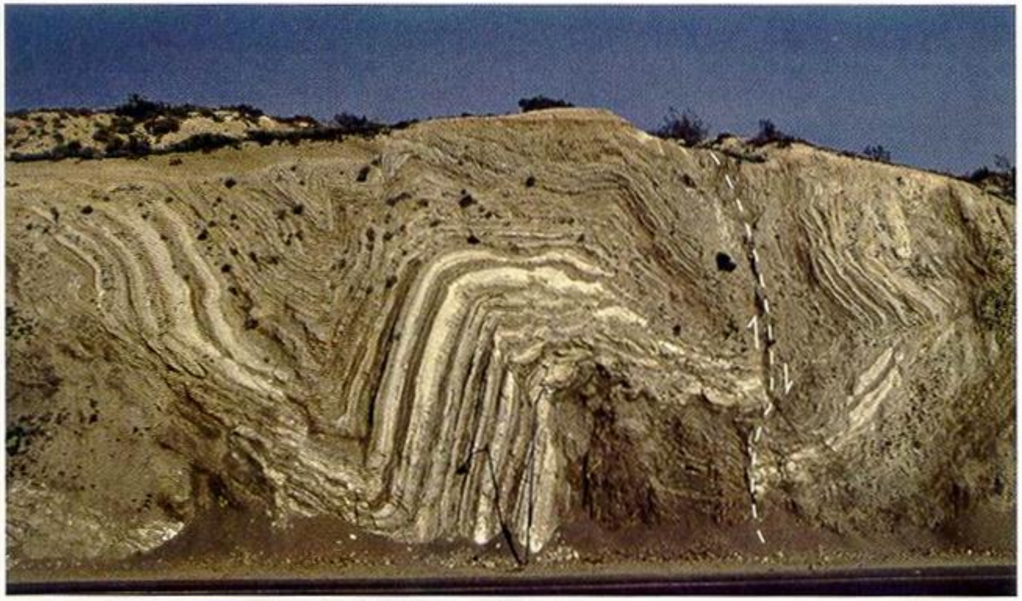


**Figure 15.5** Deformed sedimentary strata exposed in a road cut near Palmdale, California. In addition to the obvious folding, light-colored beds are offset along a fault located on the right side of the photograph. (Photo by E. J. Tarbuck)

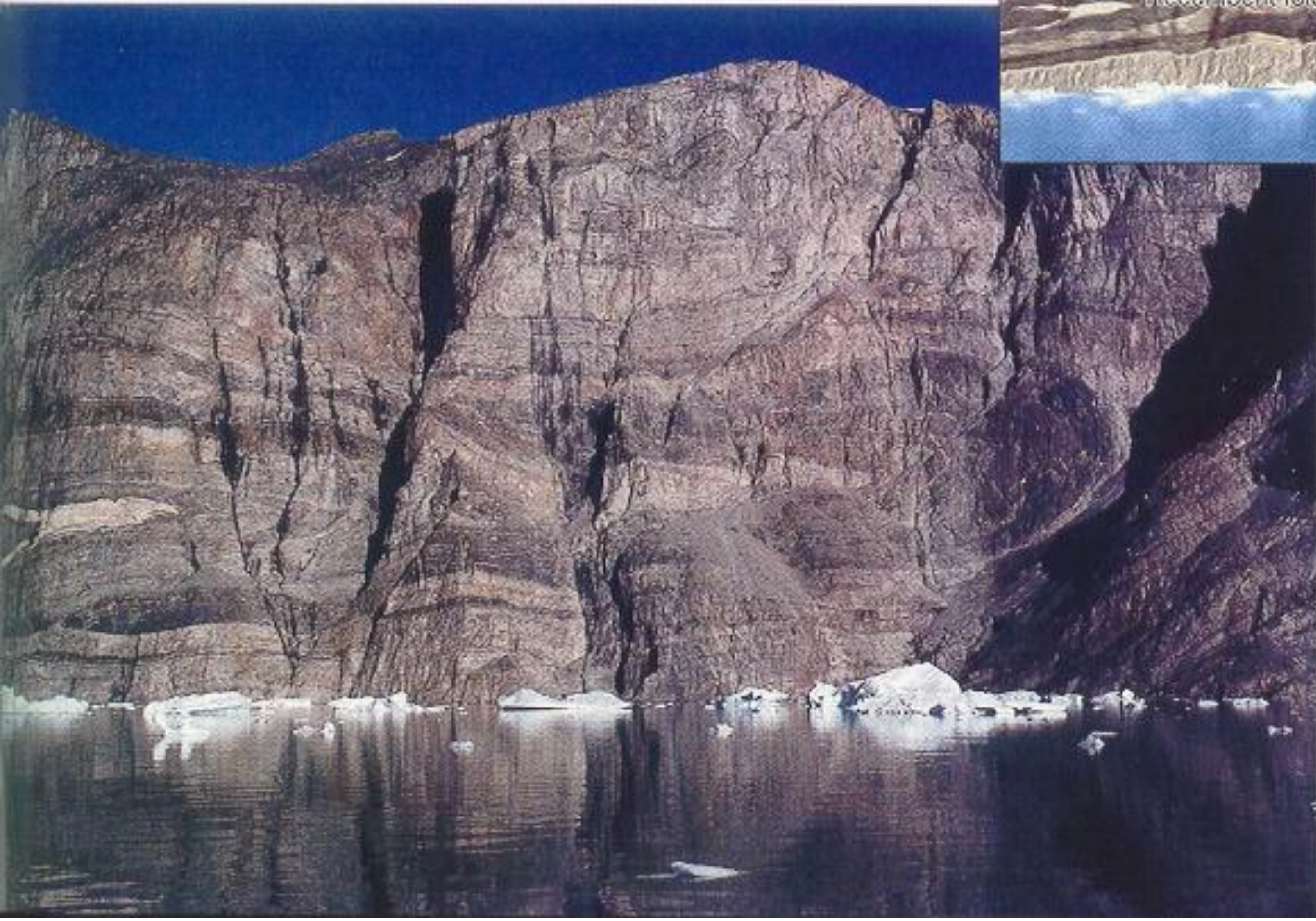



**Figure 15.11**
Recumbent fold in Precambrian rocks of the Umanak area, Greenland. (Photo by T.C.R. Pulvertaft, Geological Survey of Greenland)

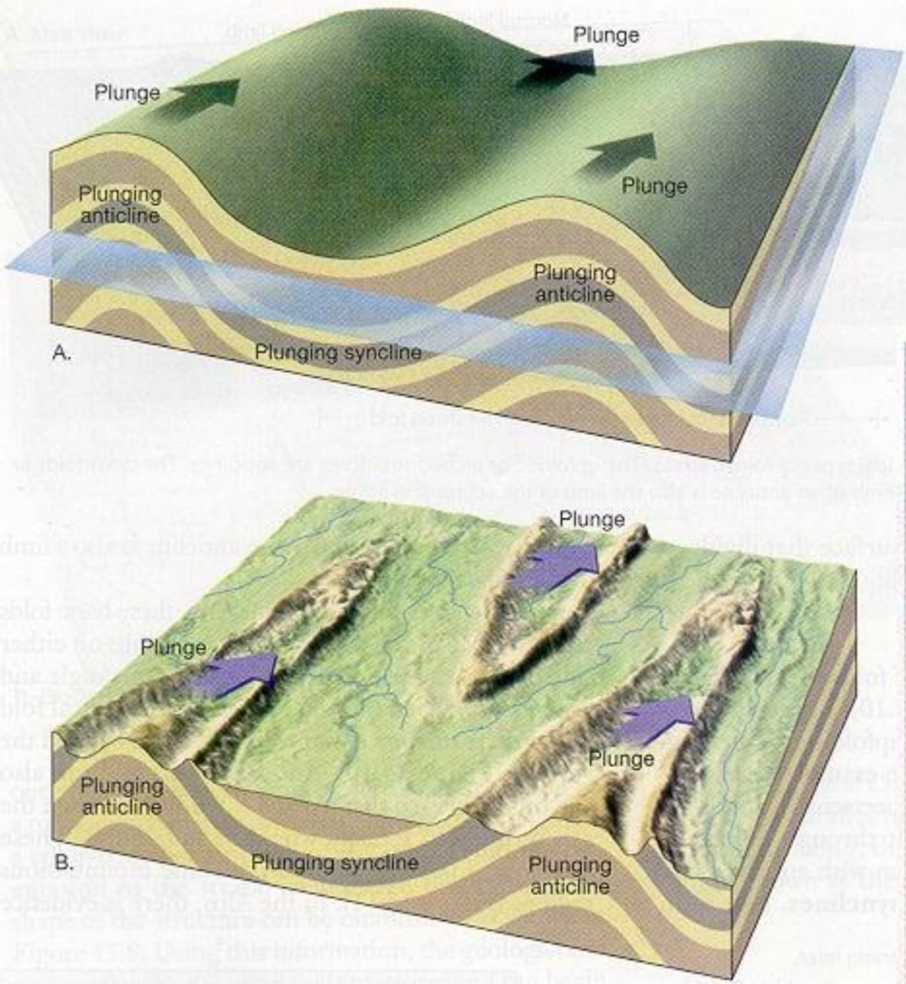
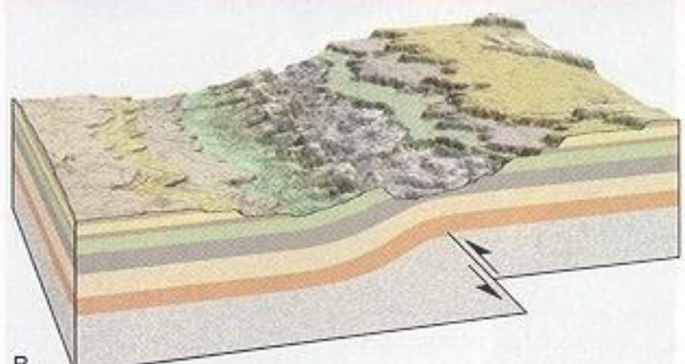



**Figure 15.12** Plunging folds. **A.** Idealized view of plunging folds in which a horizontal surface has been added. **B.** View of plunging folds as they might appear after extensive erosion. Notice that in a plunging anticline the outcrop pattern "points" in the direction of the plunge, while the opposite is true of plunging synclines.

**Figure 15.13** Sheep Mountain, a doubly plunging anticline. Note that erosion has cut the flanking sedimentary beds into low ridges that make a "V" pointing in the direction of plunge. (Photo by John S. Shelton)

A.

**Figure 15.14** Monocline. A. The San Rafael monocline, Utah. (Photo by Stephen Trimble) B. Monocline consisting of bent sedimentary beds that were deformed by faulting in the bedrock below.



B.

separated by valleys cut into more easily eroded shale or limestone beds.

Although most folds are caused by compres-

**Figure 15.18** Faulting caused the vertical displacement of these beds located near Kanab, Utah. Arrows show relative motion of rock units. (Photo by Tom Bean/DRK Photo)

**Figure 15.19** A fault scarp in an alluvial fan is visible near the bottom of this photo. Death Valley, California. (Photo by Tom Bean)

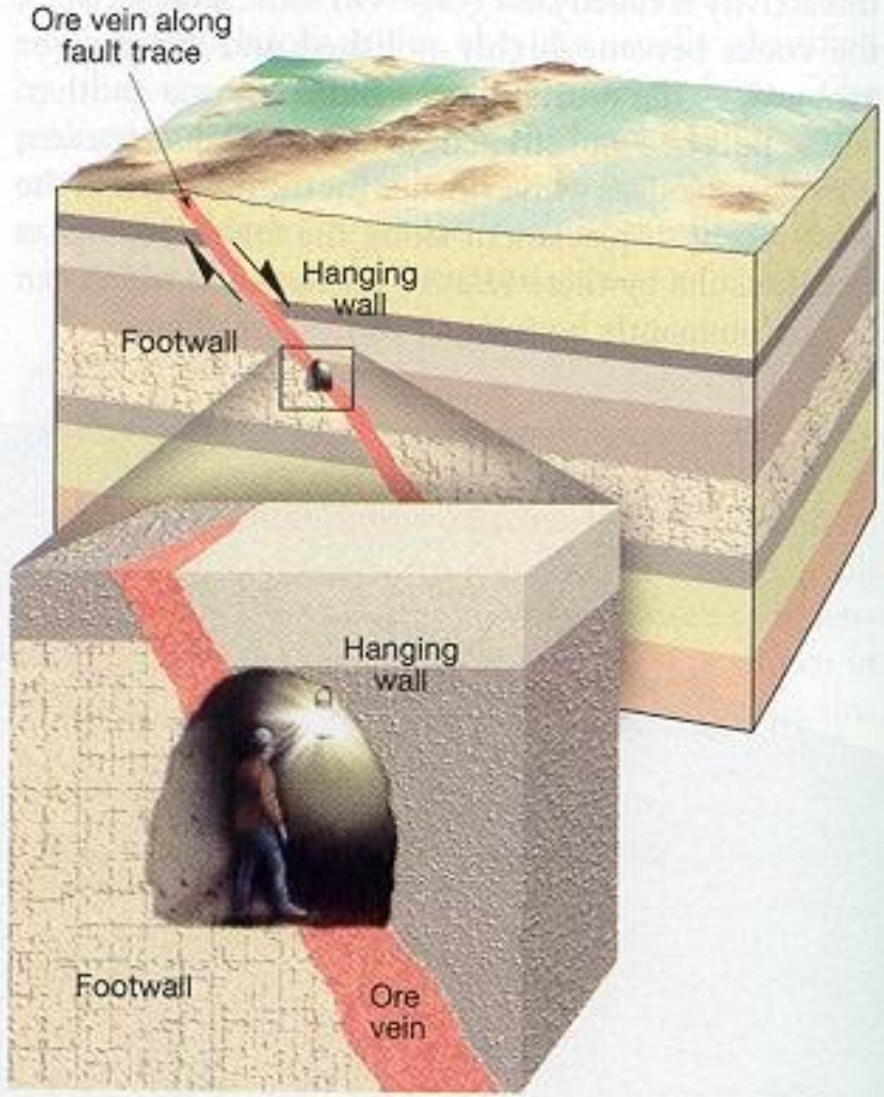



**Figure 15.20** The rock immediately above a fault surface is the *hanging wall* and that below is called the *footwall*. These names came from miners who excavated ore along fault zones. The miners hung their lanterns on the rocks above the fault trace (hanging wall) and walked on the rocks below the fault trace (footwall).

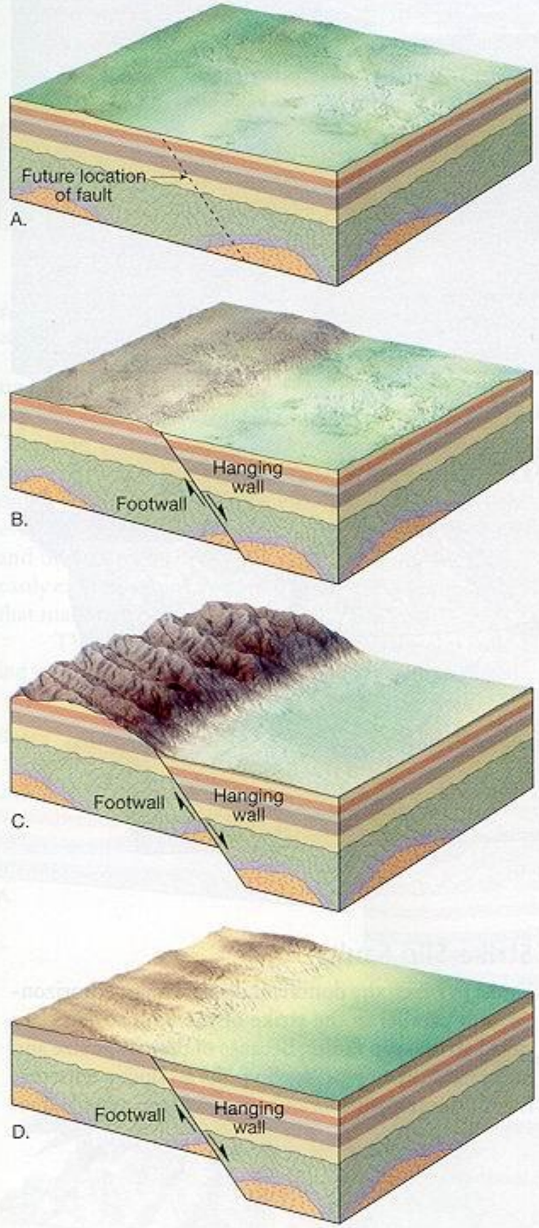



**Figure 15.21** Block diagrams illustrating a normal fault. **A.** Rock strata prior to faulting. **B.** The relative movement of displaced blocks. Displacement may continue in a fault-block mountain range over millions of years and consist of many widely spaced episodes of faulting. **C.** How erosion might alter the upfaulted block. **D.** Eventually the period of deformation ends and erosion becomes the dominant geologic process.

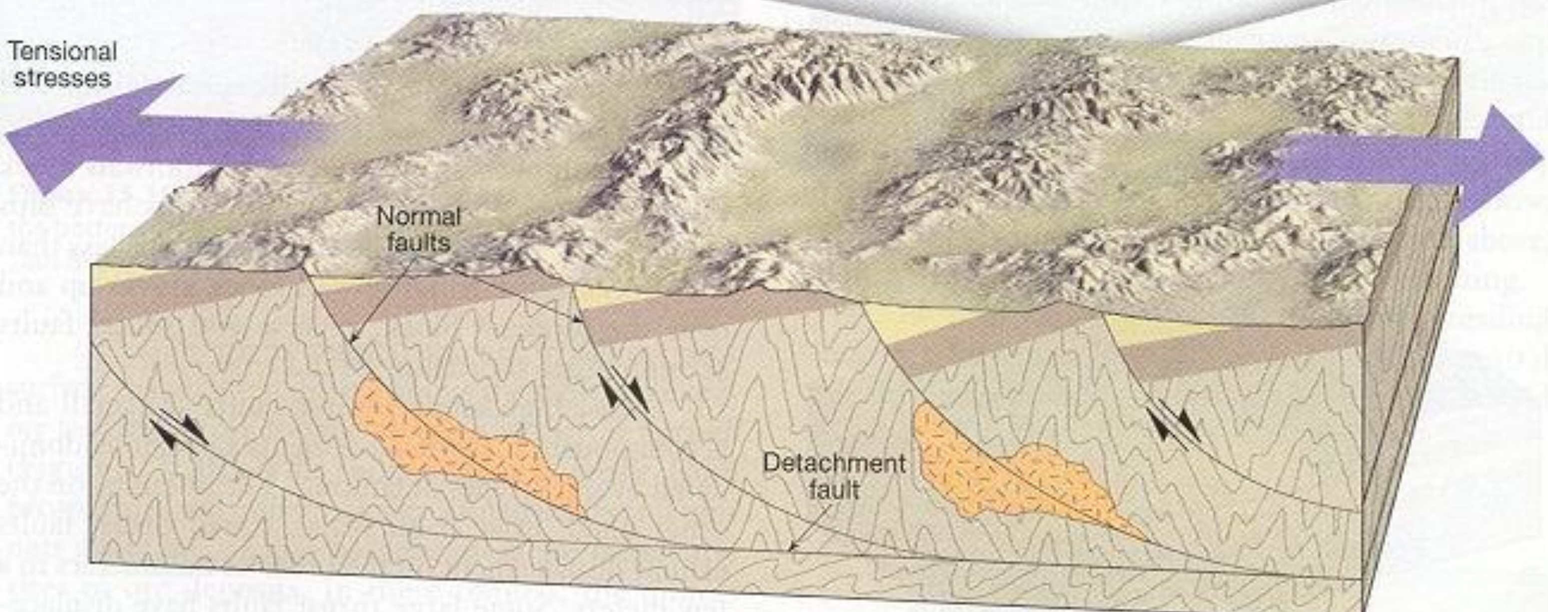



**Figure 15.22** Normal faulting in the Basin and Range Province. Here, tensional stresses have elongated and fractured the crust into numerous blocks. Movement along these fractures has tilted the blocks producing parallel mountain ranges called fault-block mountains. (Photo by Michael Collier)

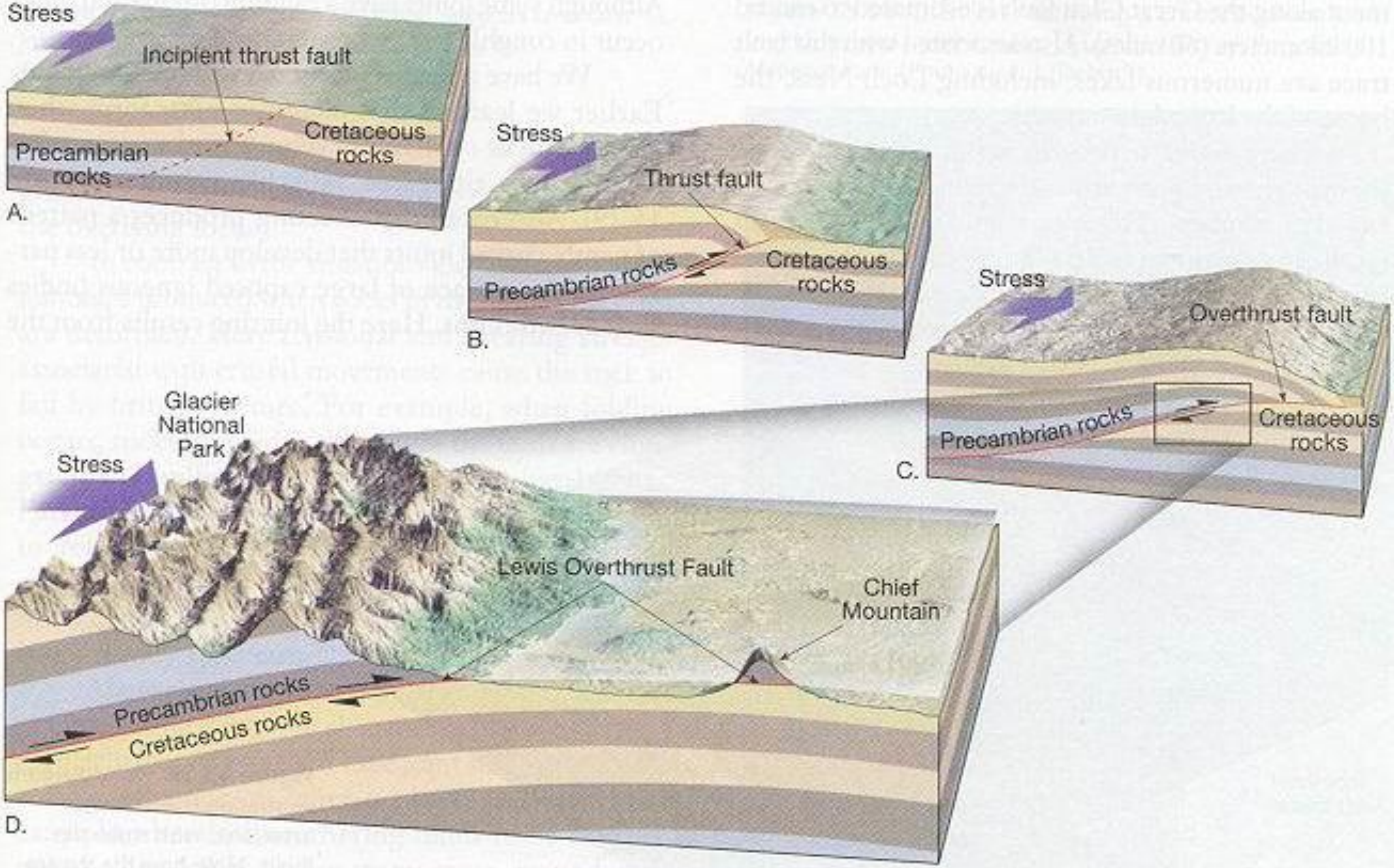
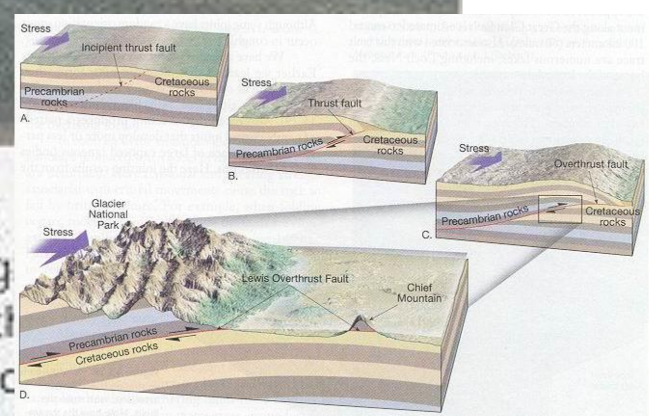



**Figure 15.26** Idealized development of Lewis Overthrust fault. **A.** Geologic setting prior to deformation. **B., C.** Large-scale movement along a thrust fault displaced Precambrian rock over Cretaceous strata in the region of Glacier National Park. **D.** Erosion by glacial ice and running water sculptured the thrust sheet into a majestic landscape and isolated a remnant of the thrust sheet called Chief Mountain.

**Figure 15.25** The Keystone Overthrust. Dark-colored Cambrian limestone has been thrust to the east over lig colored Jurassic sandstone. The irregular line between th dark- and light-colored rocks marks the fault trace, whic gently to the west (left). (Photo by John S. Shelton)

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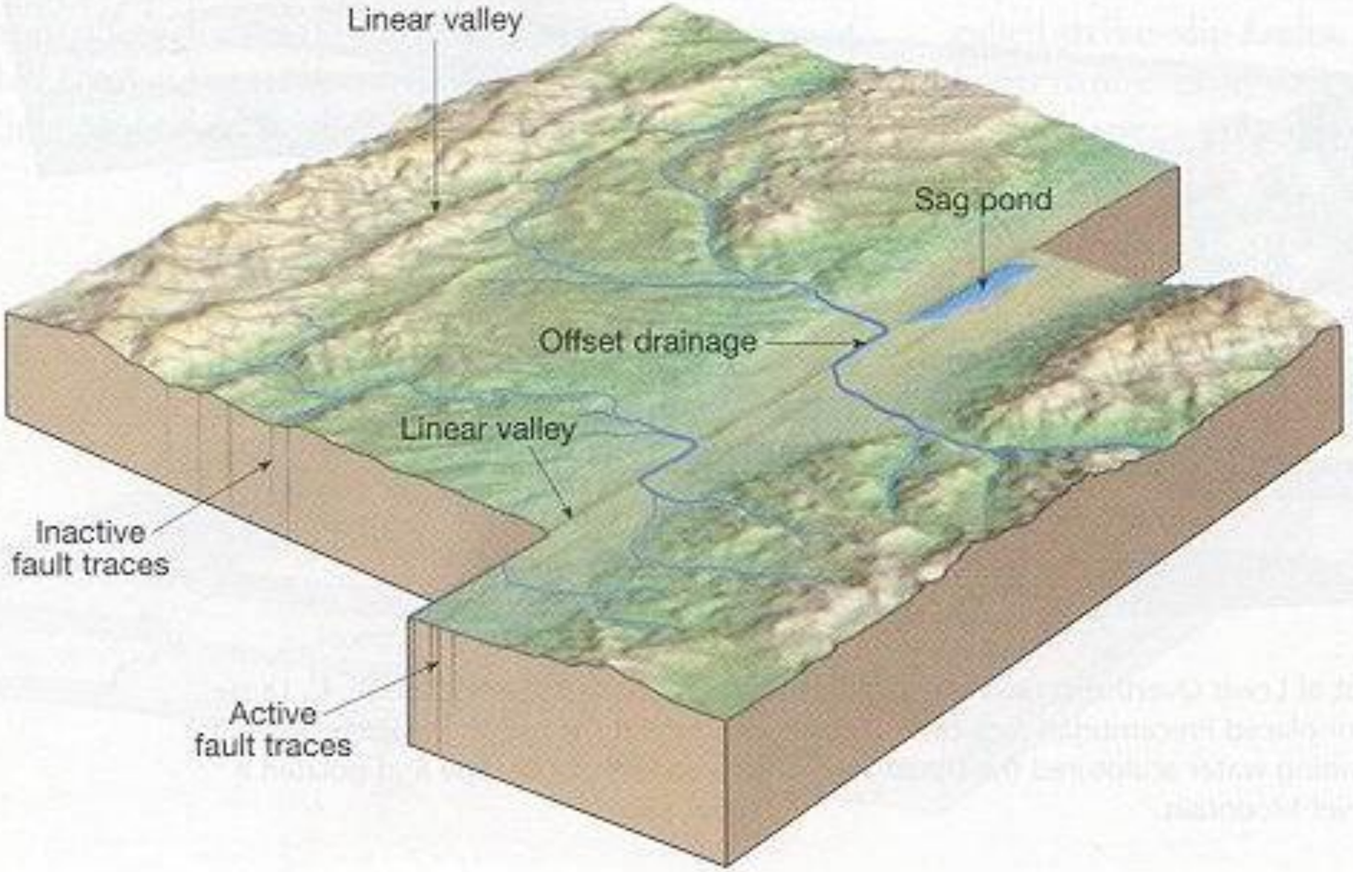



**Figure 15.28** Block diagram illustrating the features associated with strike-slip faults. Note how the stream channels have been offset by fault movement. The faults in this diagram are right-lateral strike-slip faults. (Modified after R. L. Wesson and others)

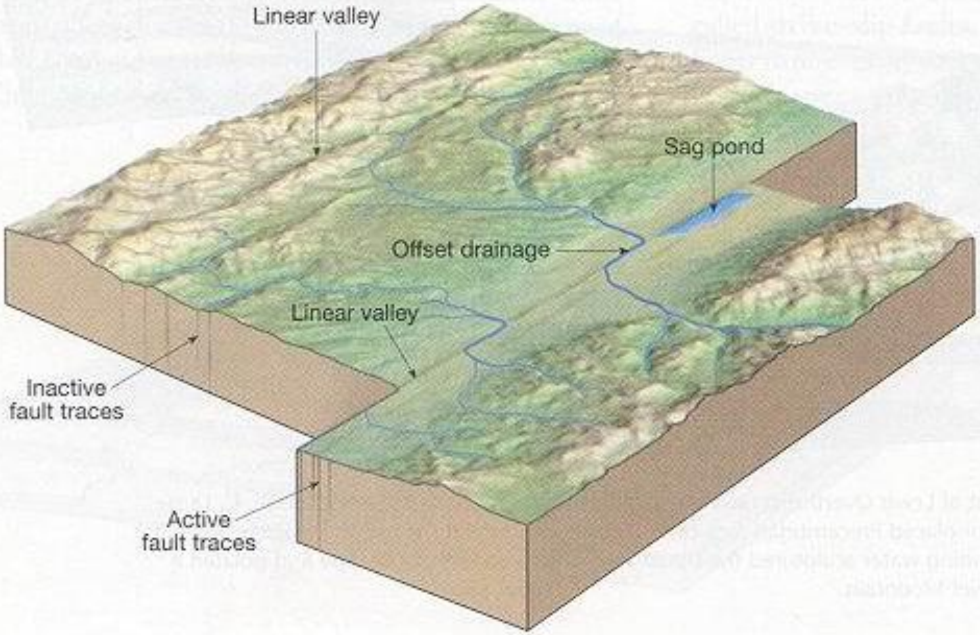




**Figure 15.C** Aerial view showing offset stream channel across the San Andreas fault on the Carrizo Plain west of Taft, California. (Photo by Michael Collier/DRK Photo)

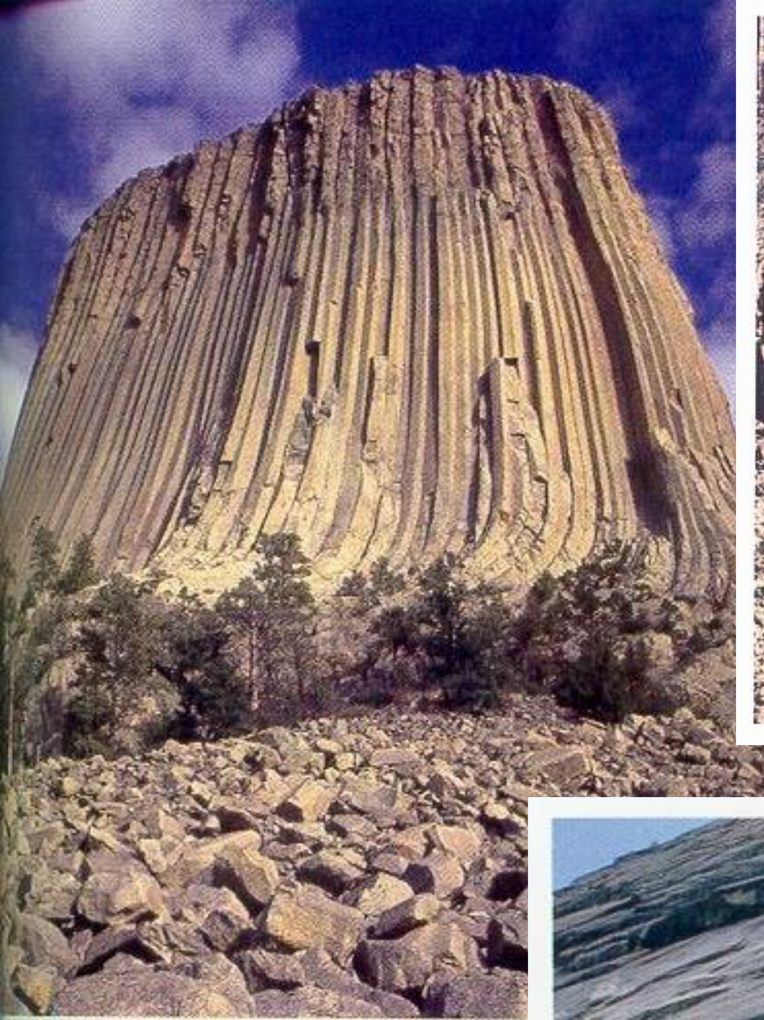


**Figure 15.29** Devil's Tower, Wyoming
joints and the columns that result. (Pho
Thomason/Tony Stone Images)

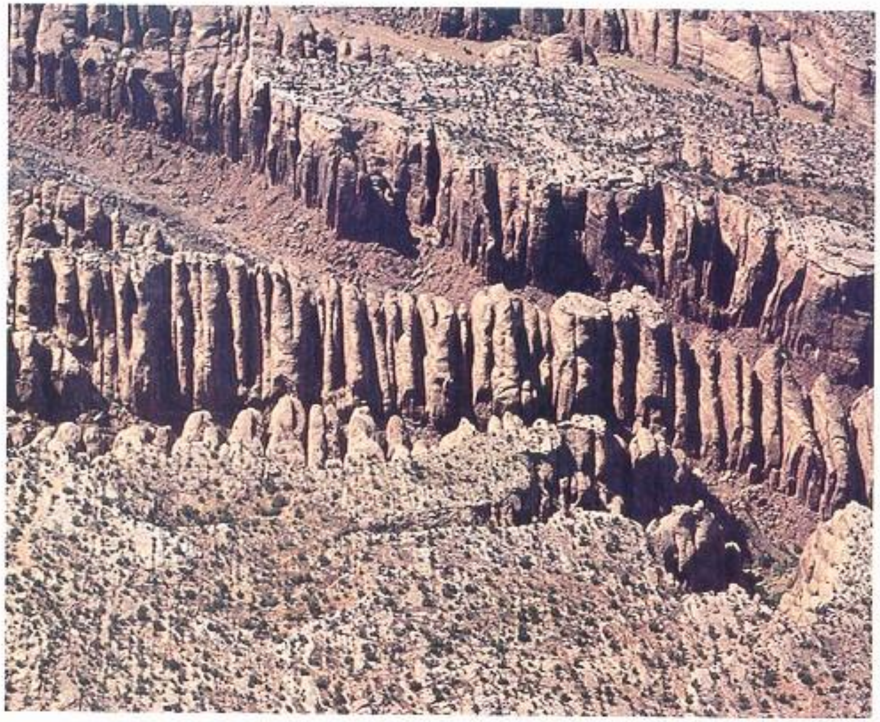
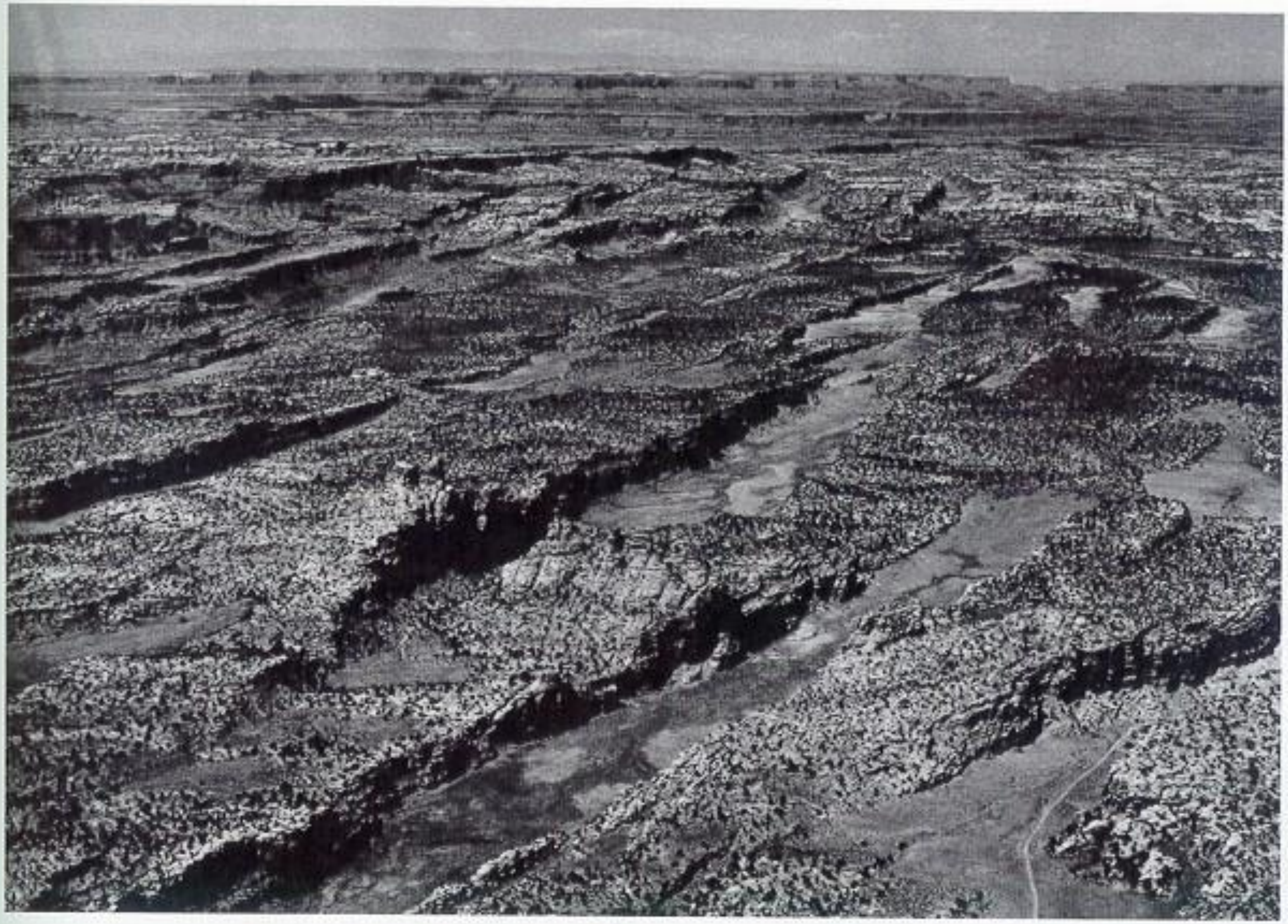


Figure 20.22
**Joint systems in resistant sandstones** in Arches National Park, Utah, have been enlarged by weathering, forming deep, narrow crevasses. The set of intersecting joints reflects the orientation of stress that deformed the rock body.

Figure 9.3
**Sheeting in granite** of the Sierra Nevada occurs as erosion removes the overlying rock cover and reduces the confining pressure. The bedrock expands and large fractures develop parallel to the surface. The fractures may subsequently be enlarged by frost action.



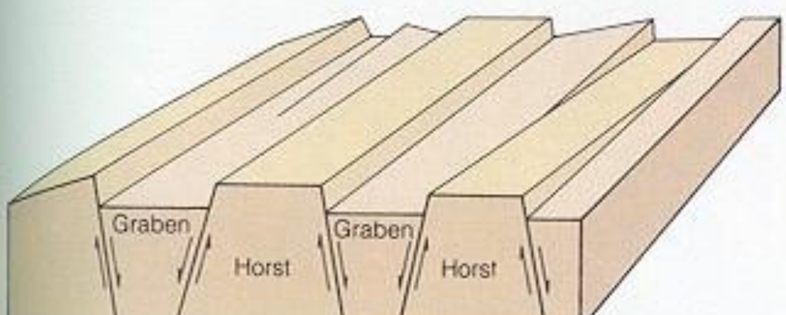



**Figure 20.16**
**Horsts and grabens** in Canyonlands National Park, Utah, are clearly expressed at the surface. Grabens (downdropped blocks) form elongate valleys, which are partly covered with a smooth flat veneer of sediment. Horsts (upraised blocks) form elongate ridges. Relative movement along the major faults is shown in the idealized diagram.

**Figure 20.19**
**Strike-slip faults** produce distinctive landforms. Streams are offset by recurrent movement, linear ridges and valleys form, and local sag ponds develop along the fault line.

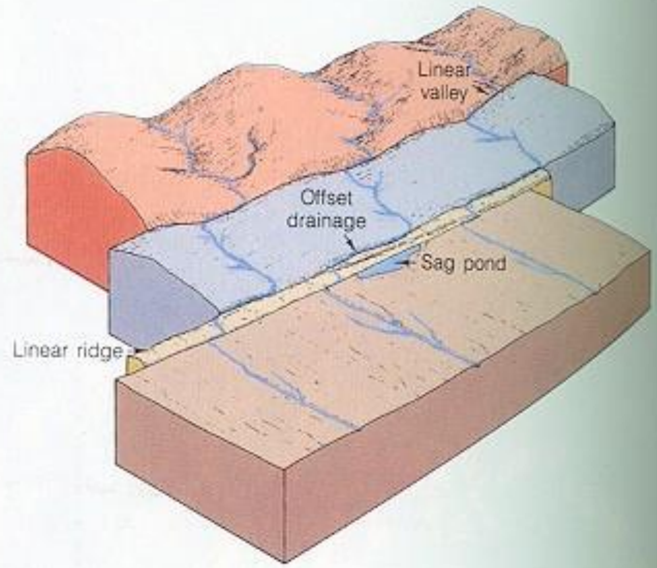



**Figure 20.20**
**The San Andreas Fault,** in California, is a major strike-slip fault. It is delineated by prominent, straight ridges and valleys. Recent movement along the fault has offset the drainage patterns on either side of the fault. Relative movement between the fault blocks is evident from the direction in which the drainage is offset.