Chapter 8

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Geology of Groundwater Occurrence

Figure 8.42. Alluvial Valleys ground-water region.

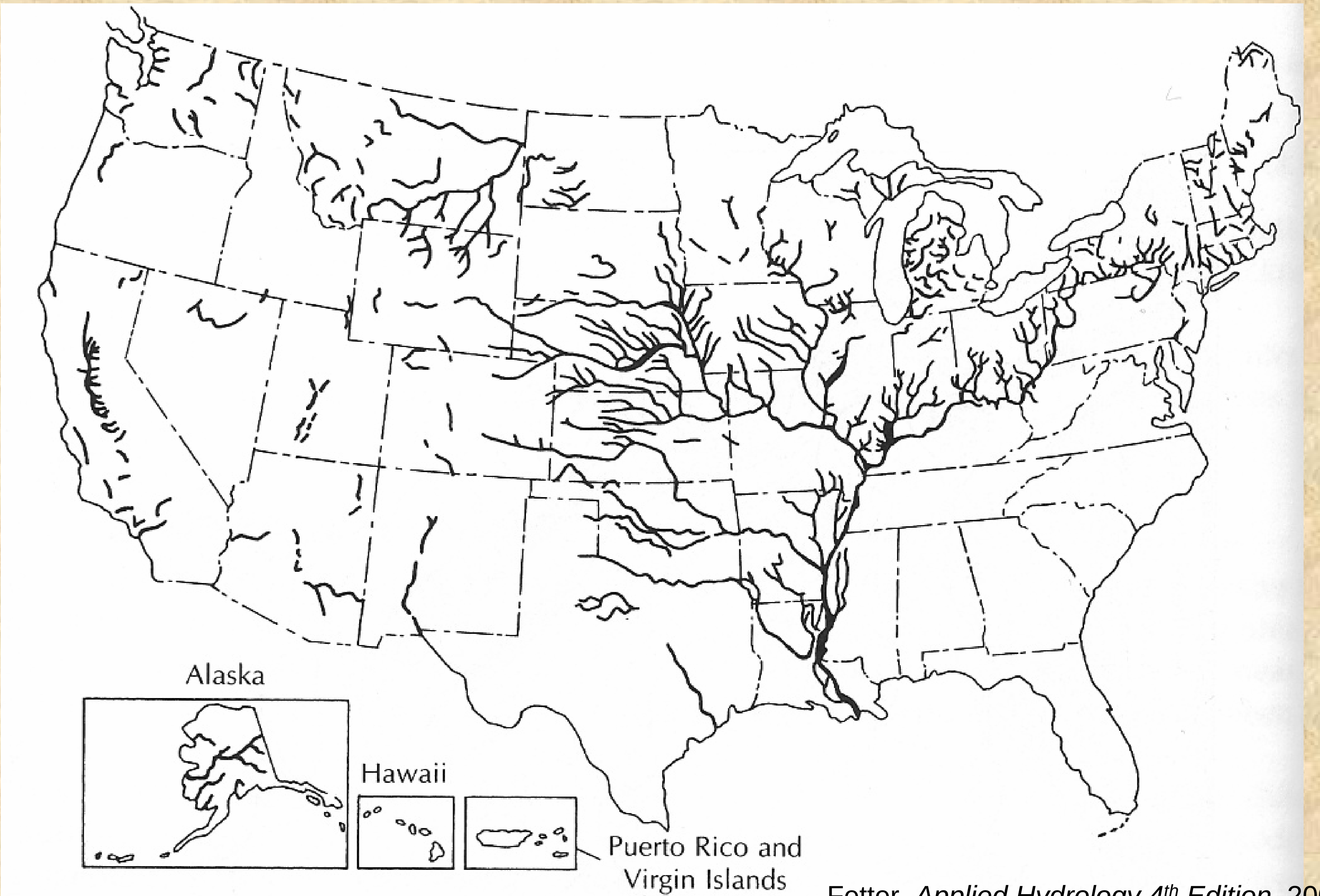

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Figure 8.41. Ground-water regions of the United States.

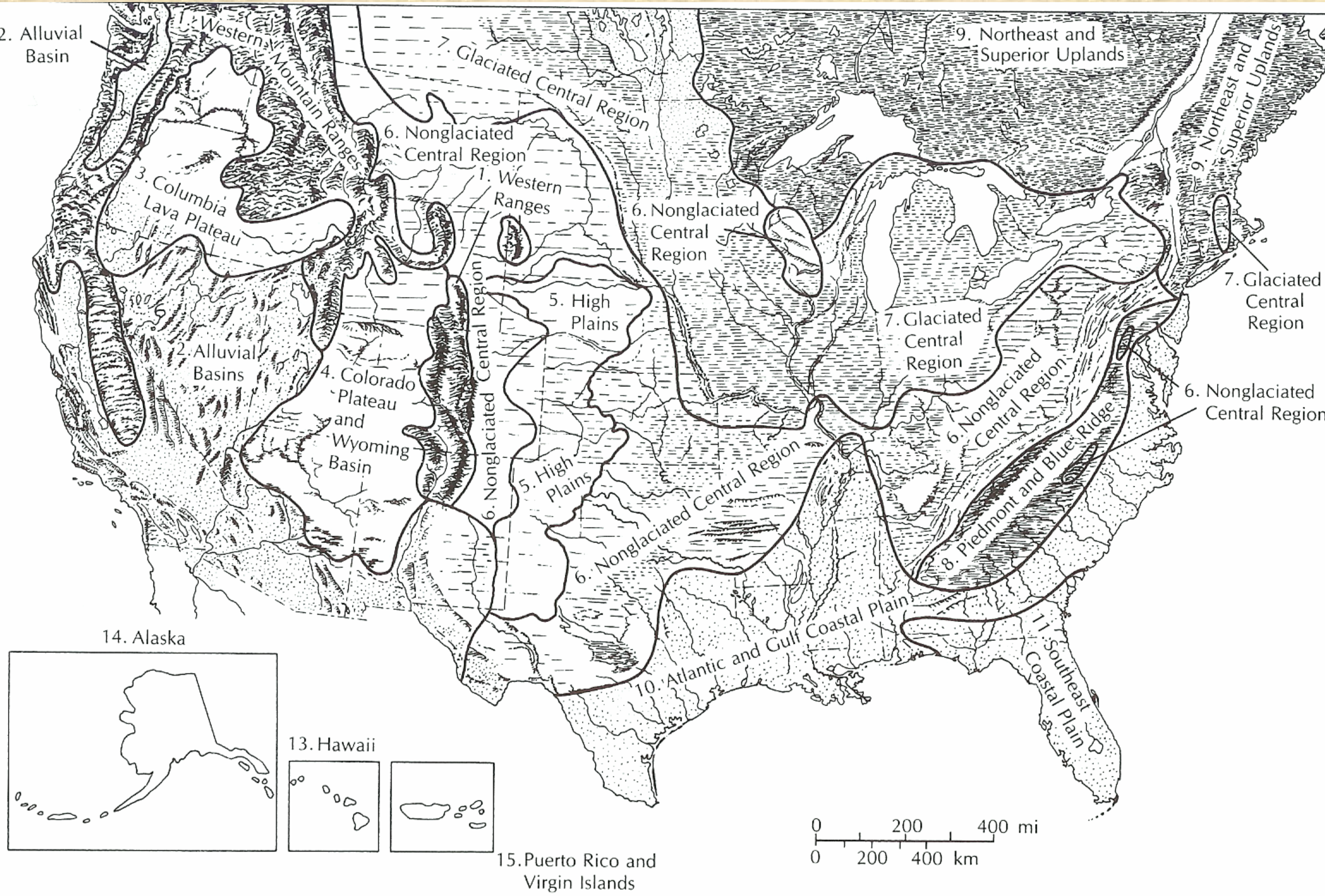

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Figure 8.1 Distribution of sediments in a glaciated terrane.

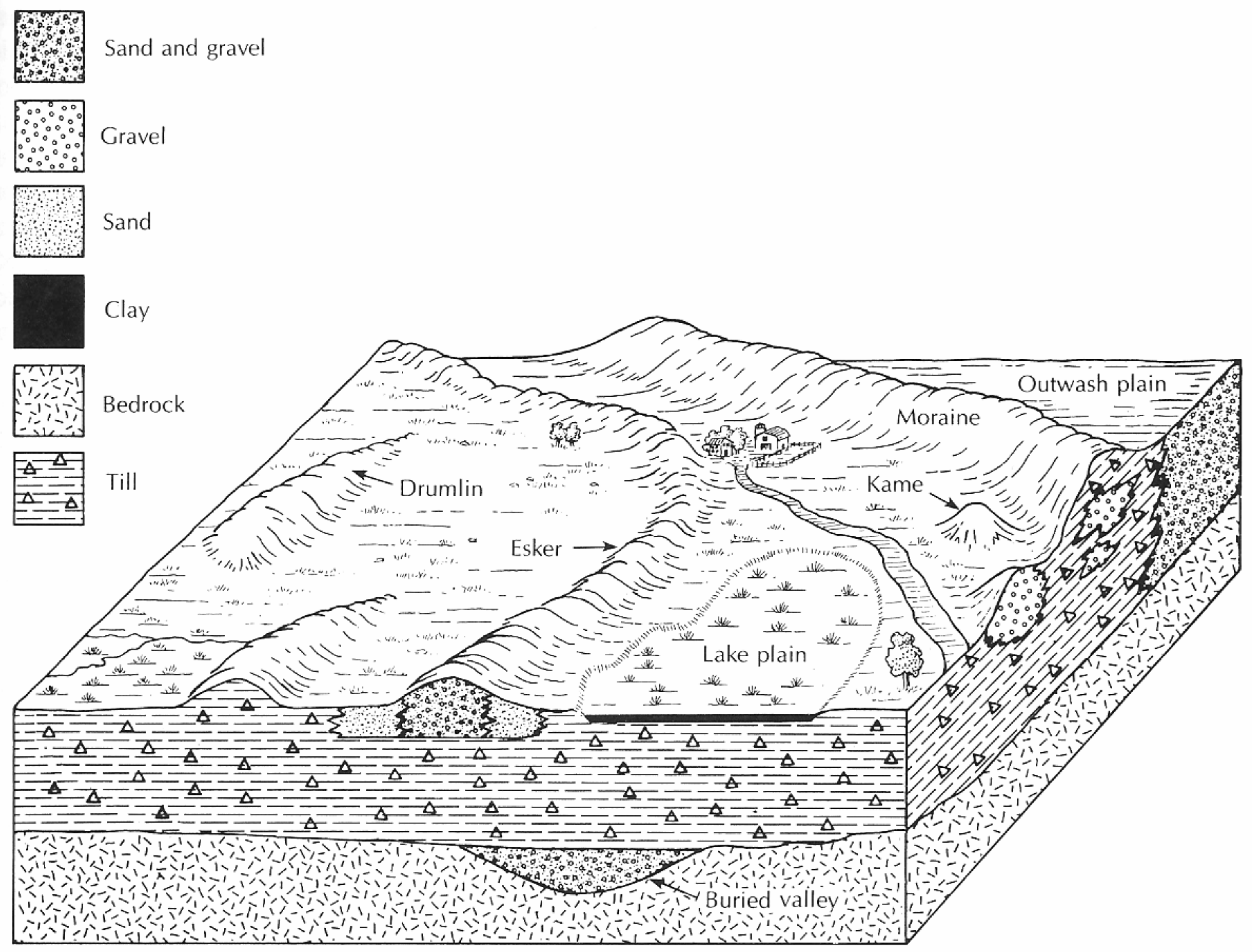

Figure 8.2 Complex glacial stratigraphy in the Mesabi Iron Range, Minnesota. Sand and gravel and glaciofluvial sediments are potential aquifers.

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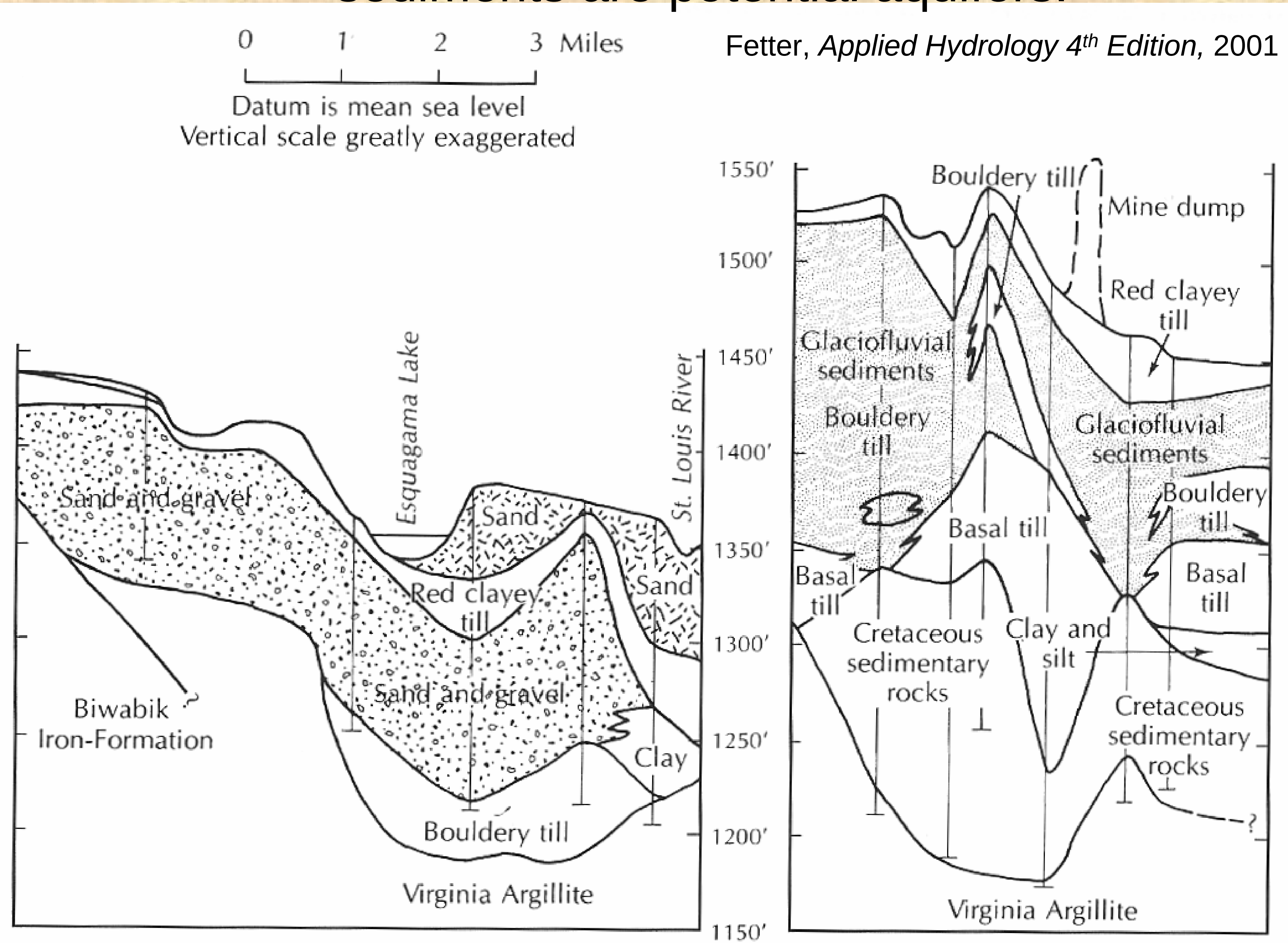

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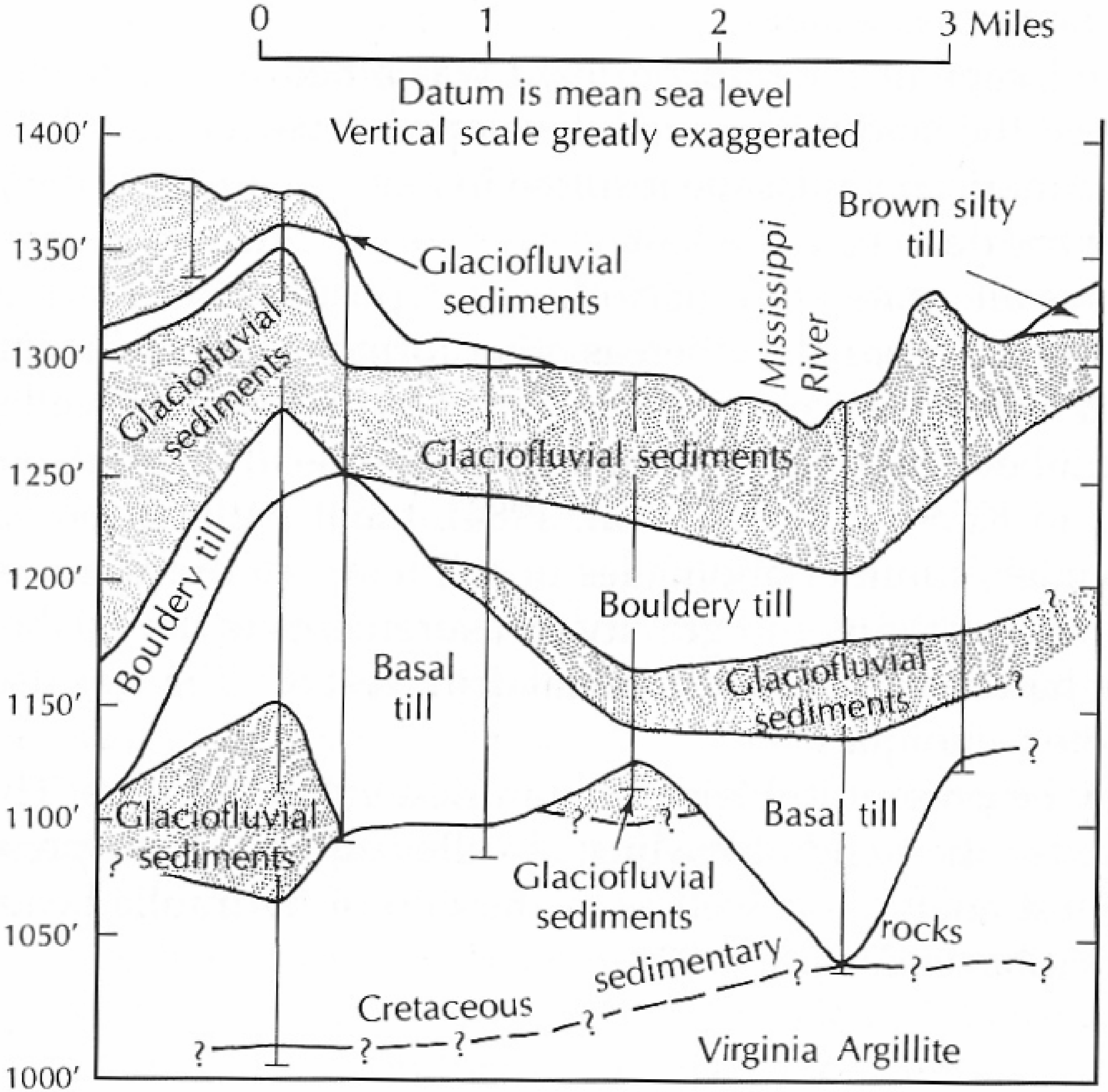

Figure 8.2 Complex glacial stratigraphy in the Mesabi Iron Range, Minnesota. Sand and gravel and glaciofluvial sediments are potential aquifers.

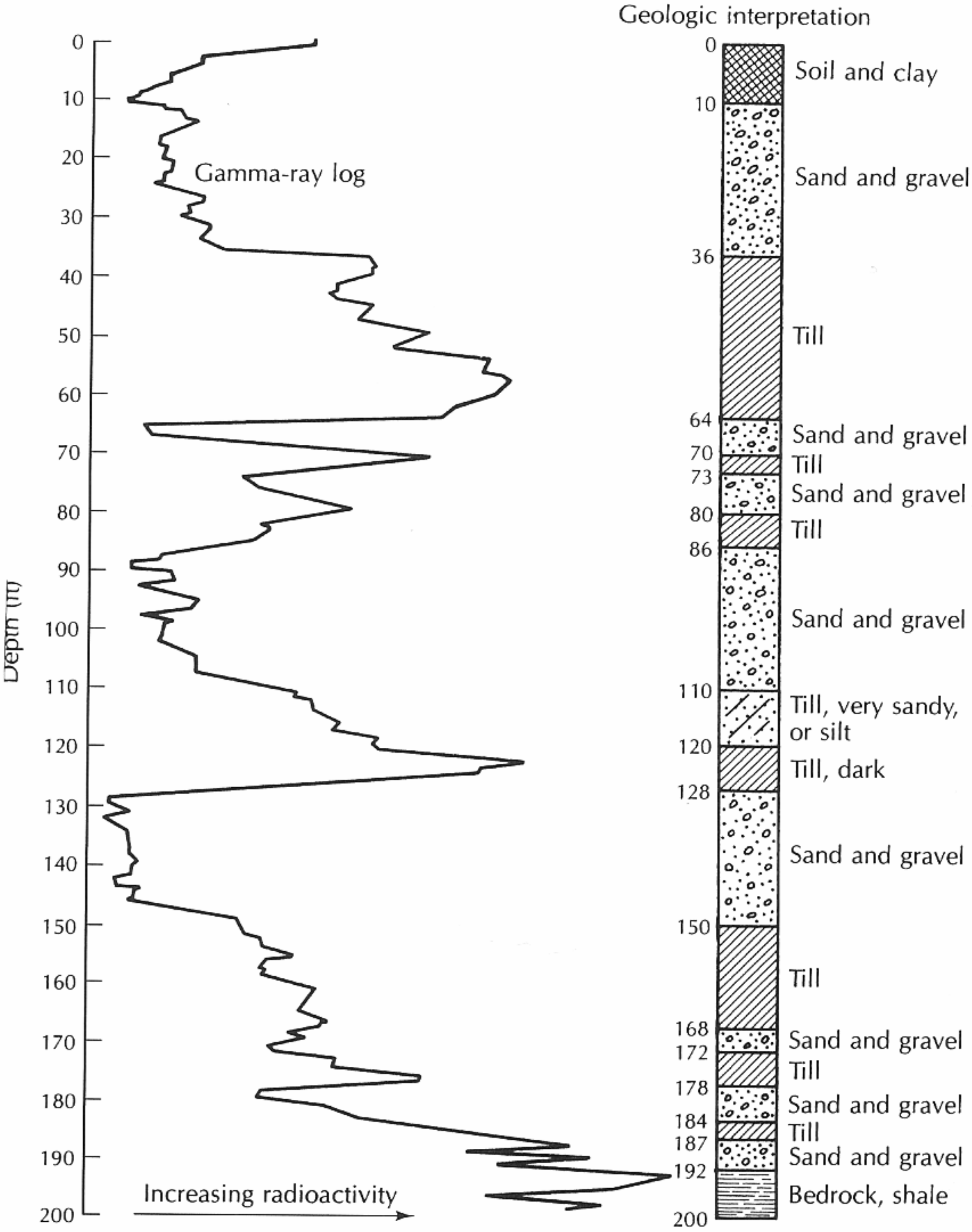

Figure 8.3. Well log and gamma-ray log of uncased test hole in glacial deposits filling a buried bedrock valley south of Dayton, Ohio.

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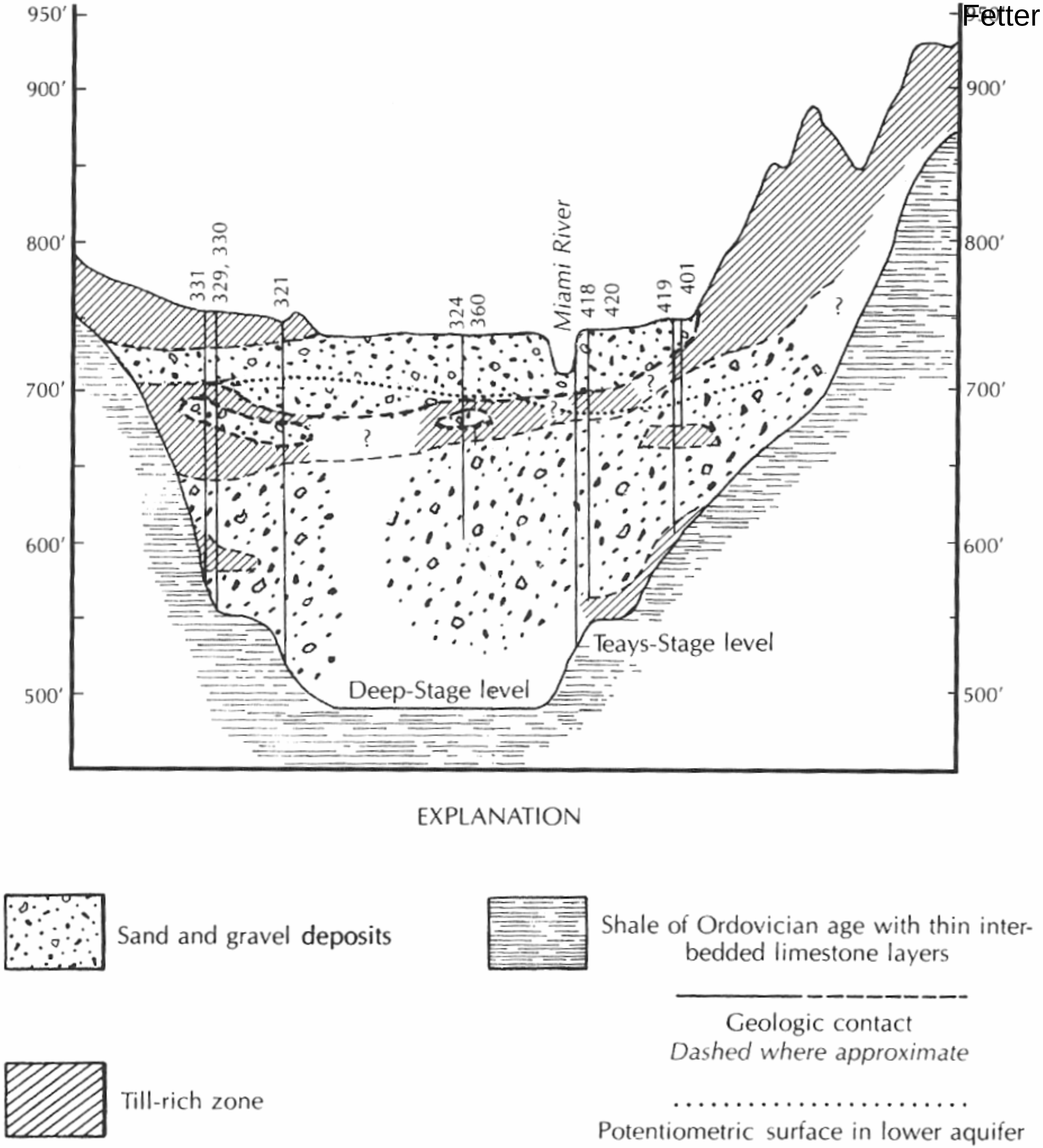

Figure 8.4. Cross section of buried bedrock at Dayton, Ohio, showing upper (water-table) aquifer and lower (confined) aquifer.

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Figure 8.41. Ground-water regions of the United States.

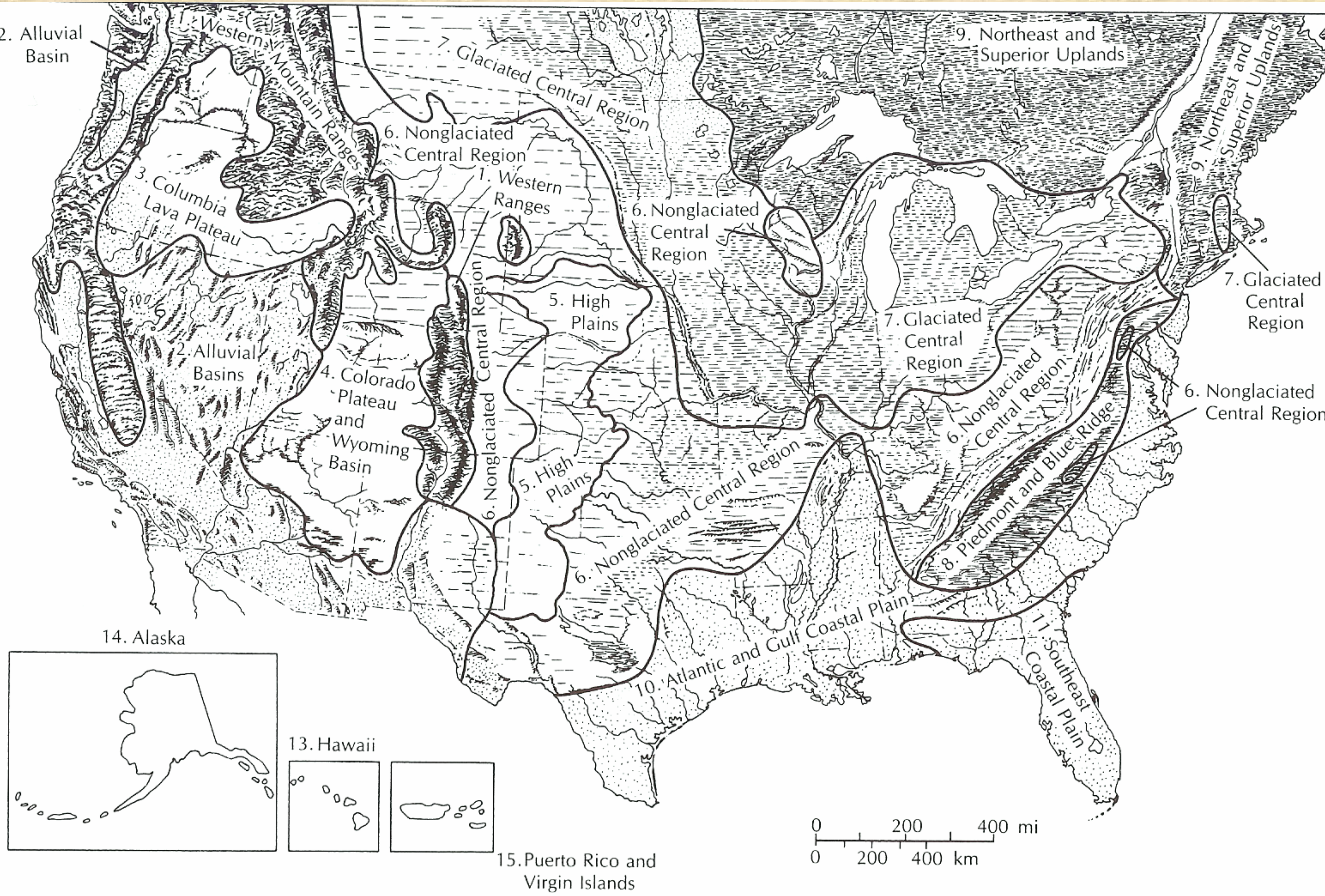

Figure 8.6 Common ground-water flow systems in tectonic valley filled with sediment. Basins bounded by impermeable rock may form local or single-valley flow systems. If the interbasin rock is permeable, regional flow systems may form. In closed basins, ground water discharges into playas, from which it is discharged by evaporation and transpiration by phreatophytes.

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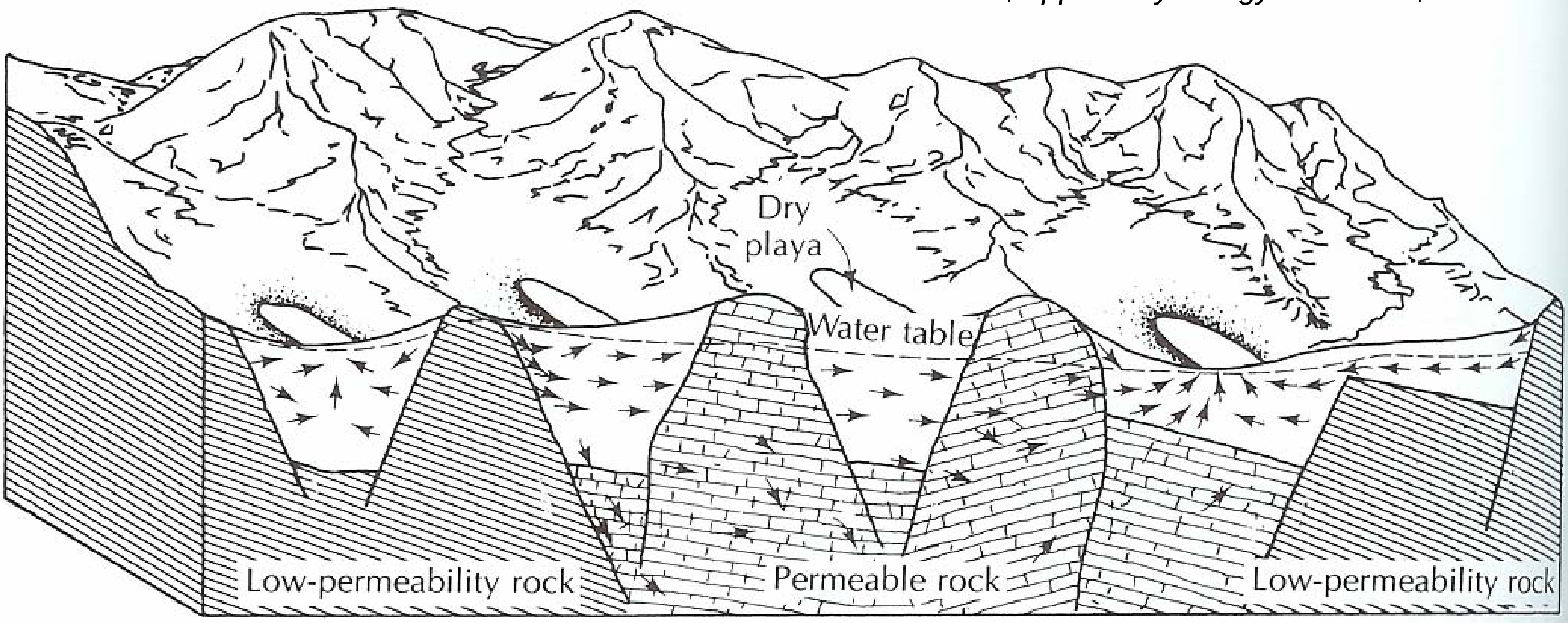

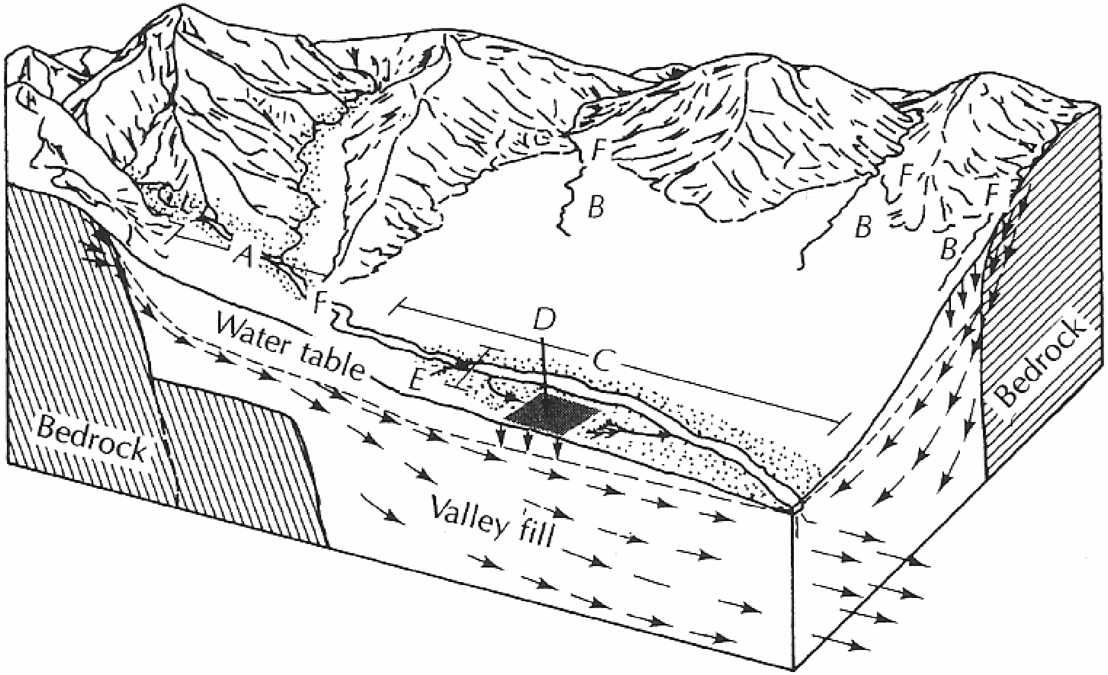

A, Gaining reach, net gain from ground-water inflow, although in localized areas stream may recharge wet meadows along floodplain. Hydraulic continuity is maintained between stream and ground-water reservoir. Pumping can affect streamflow by inducing stream recharge or by diverting ground-water inflow that would have contributed to streamflow.

B, Minor tributary streams, may be perennial in the mountains but become losing ephemeral streams on the alluvial fans. Pumping will not affect the flow of these streams because hydraulic continuity is not maintained between streams and the principal groundwater reservoir. These streams are the only ones present in arid basins.

C, Losing reach, net loss in flow due to surface-water diversions and seepage to ground water. Local sections may lose or gain depending on hydraulic gradient between stream and ground-water reservoir. Gradient may reverse during certain times of the year. Hydraulic continuity is maintained between stream and groundwater reservoir. Pumping can affect streamflow by inducing recharge or by diverting irrigation return flows.

D, Irrigated area, some return flow from irrigation water recharges ground water.

E, Floodplain, hydrologic regimen of this area dominated by the river. Water table fluctuates in response to changes in river stage and diversions. Area commonly covered by phreatophytes (shown by random dot patterns).

F, Approximate point of maximum stream flow.

Figure 8.7 Ground-water-surface-water relationships in valley-fill aquifers located in arid and semiarid climates.

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Regional Groundwater Flow near Nevada Test Site. Fetter, Fig 7.15

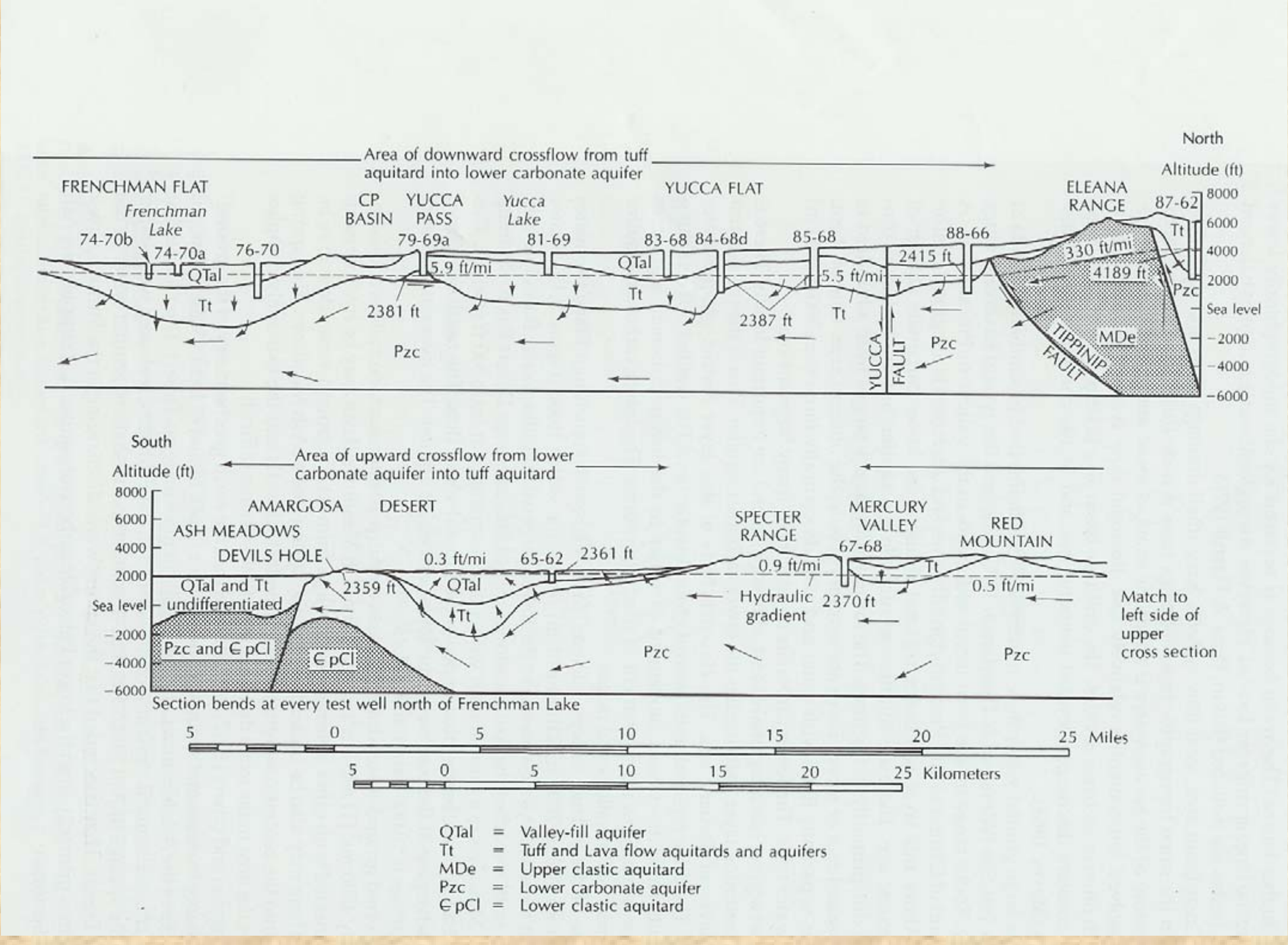
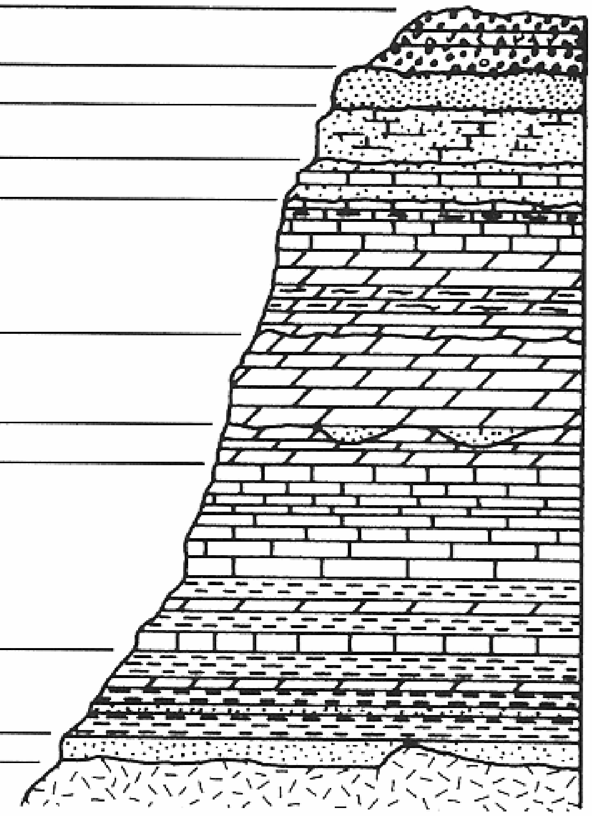


Figure 8.14 Stratigraphy of the Grand Canyon area.

Unit	Age	Thickness (ft)
Gravels, Basalt, Tuff	Tertiary	0–1000
Wescogame Formation	Pennsyl- vanian	200
Manakacha Formation		250
Watahomigi Formation		200
Redwall Limestone	Missis- sippian	600–675
Temple Butte Formation	Devon- ian	400–450
Undivided	Cambrian	175
Muav Limestone		800–1200
Bright Angel Shale		400–450
Tapeats Sandstone		0-225
Vishnu Schist	Precambrian	

Lithology



EXPLANATION

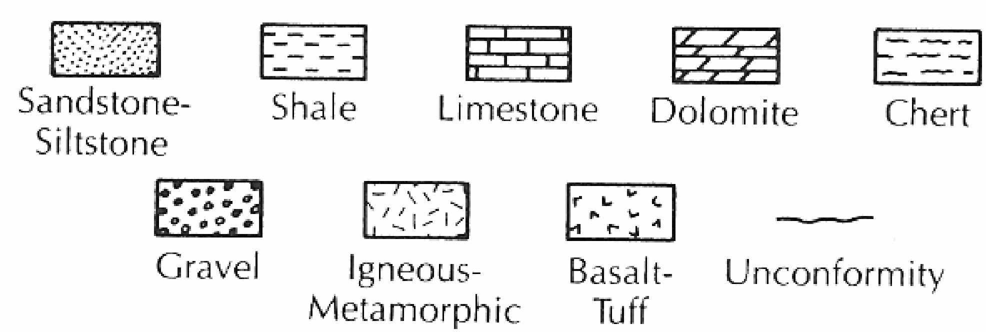


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Figure 8.15. Interfingering of sedimentary rock units of the Hualapai Plateau area.

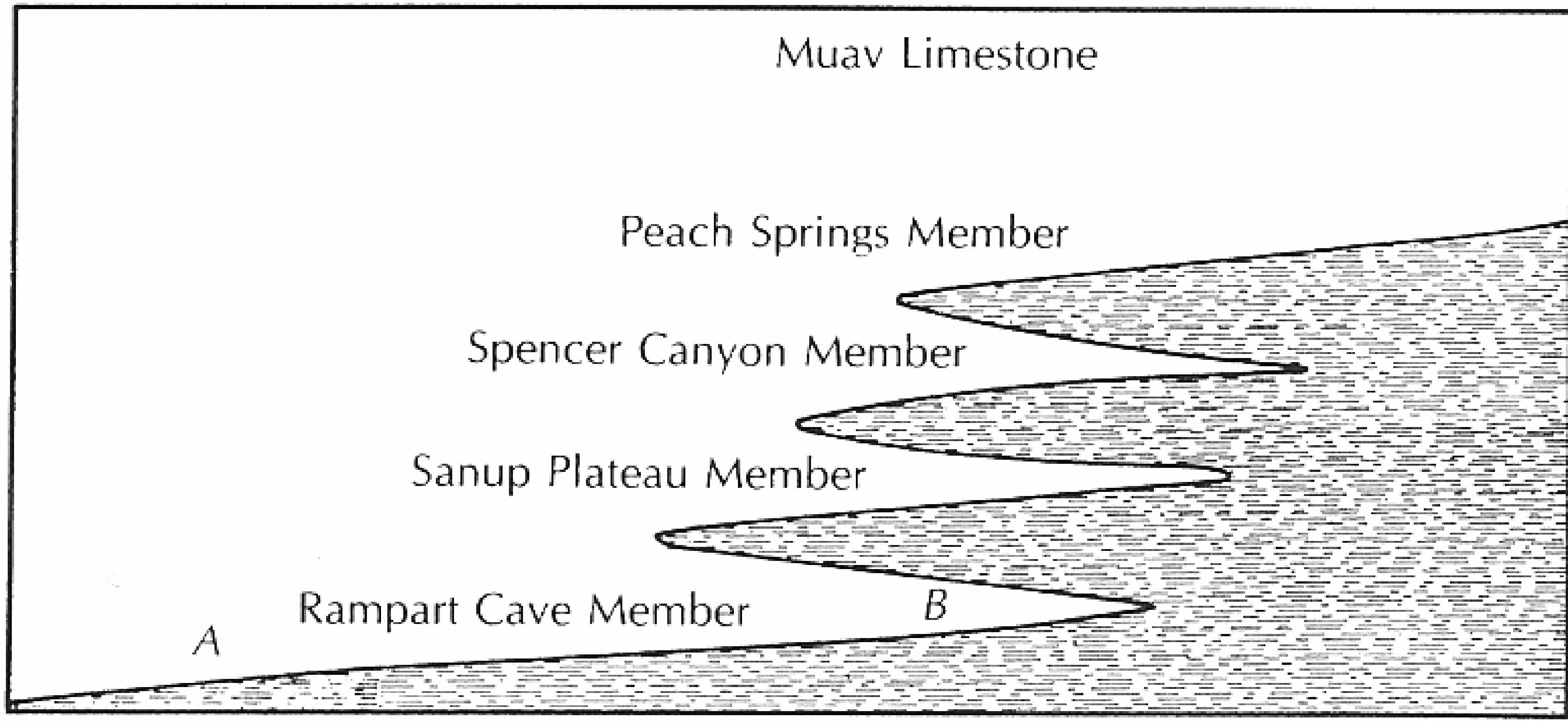

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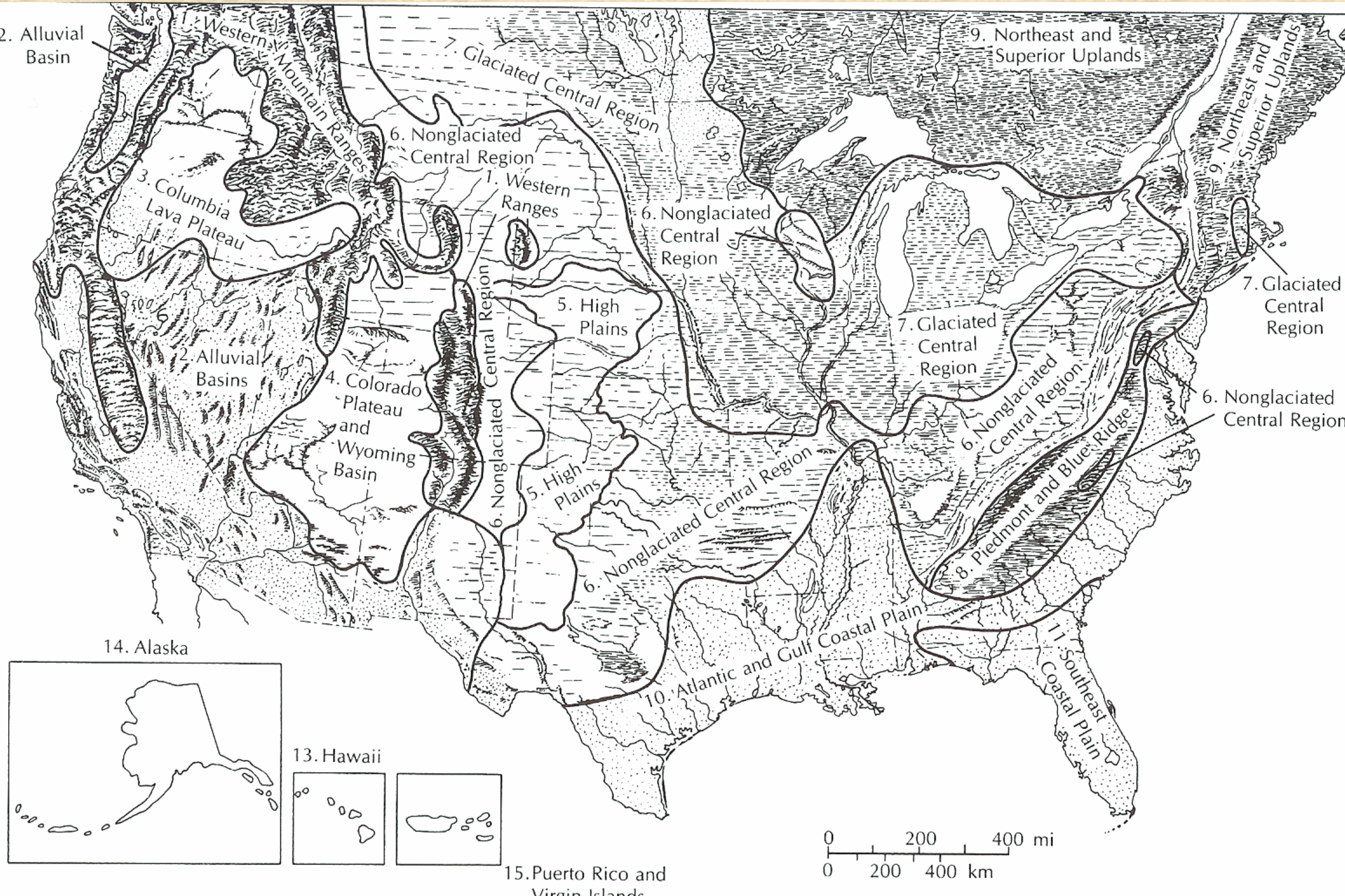
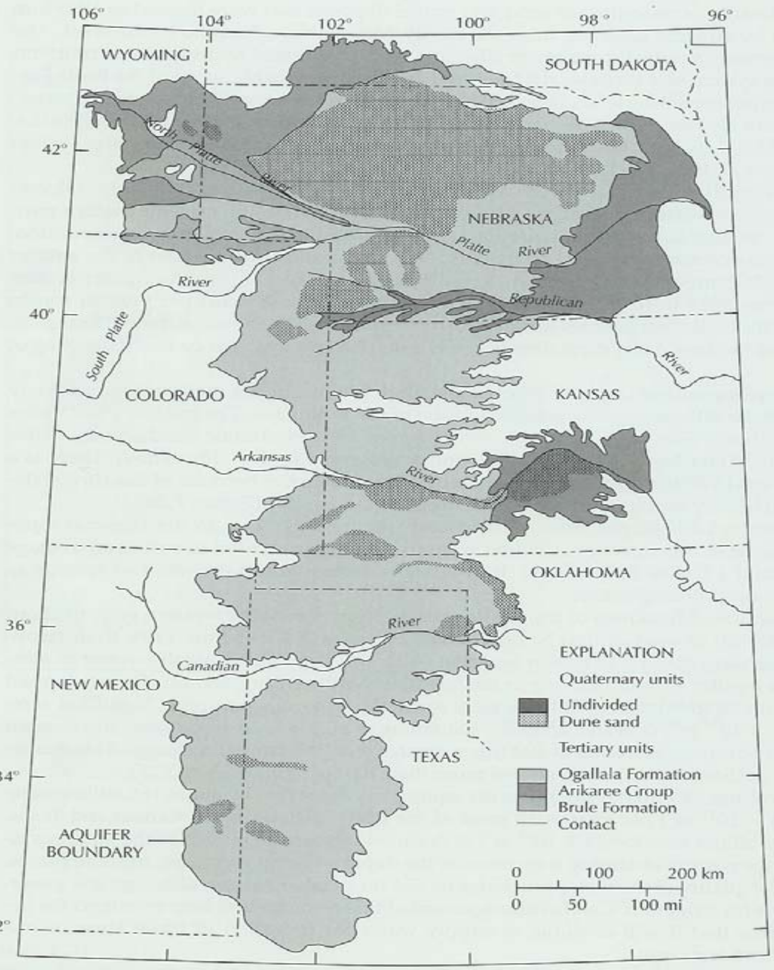
Figure 8.41. Ground-water regions of the United States.



Geological Units of High Plains Aquifer. Fetter, Fig. 7.22



▲ FIGURE 7.22

Principal geologic units of the High Plains aquifer. *Source: E. D. Gutentag, F. J. Heimes, N. C. Krothe, R. R. Luckey, & J. B. Weeks, U.S. Geological Survey Professional Paper 1400-B, 1984.*

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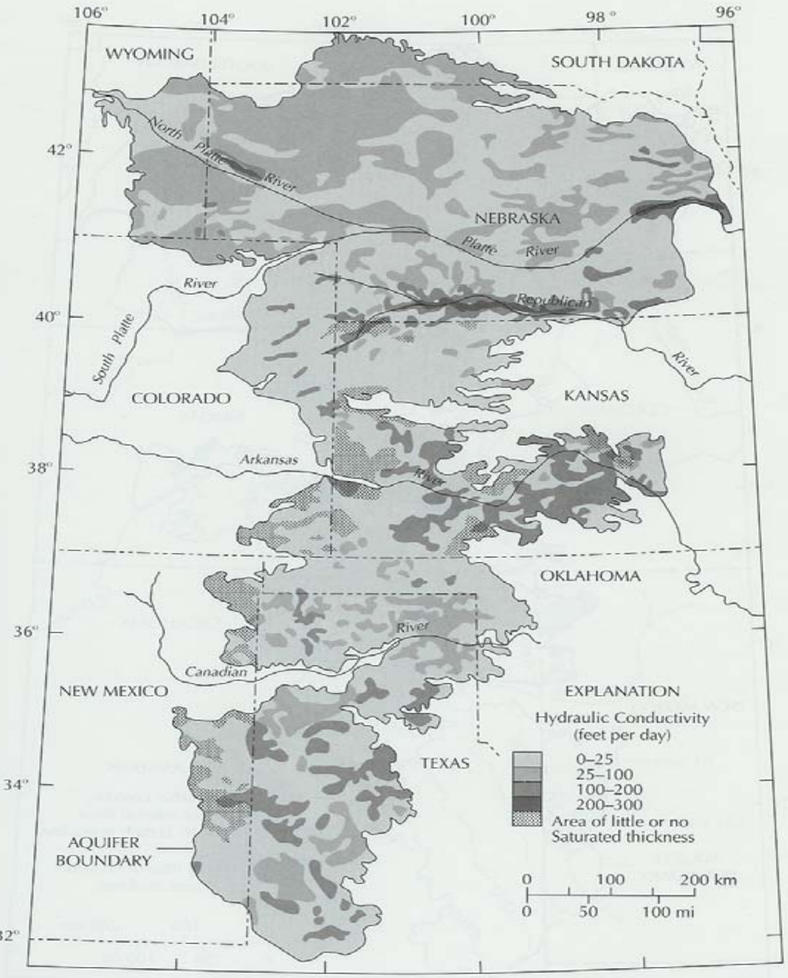
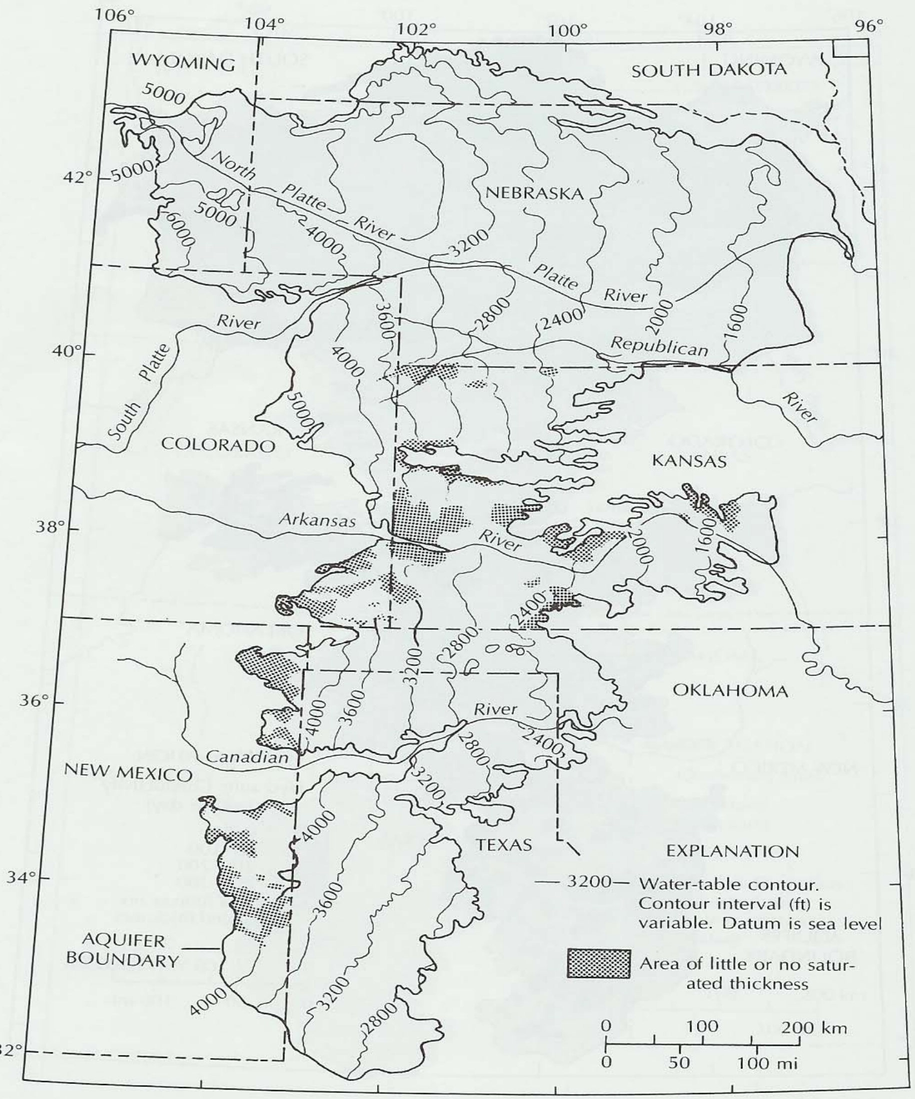
Areal Distribution of Hydraulic Conductivity in High Plains Aquifer. Fetter, Fig. 7.23



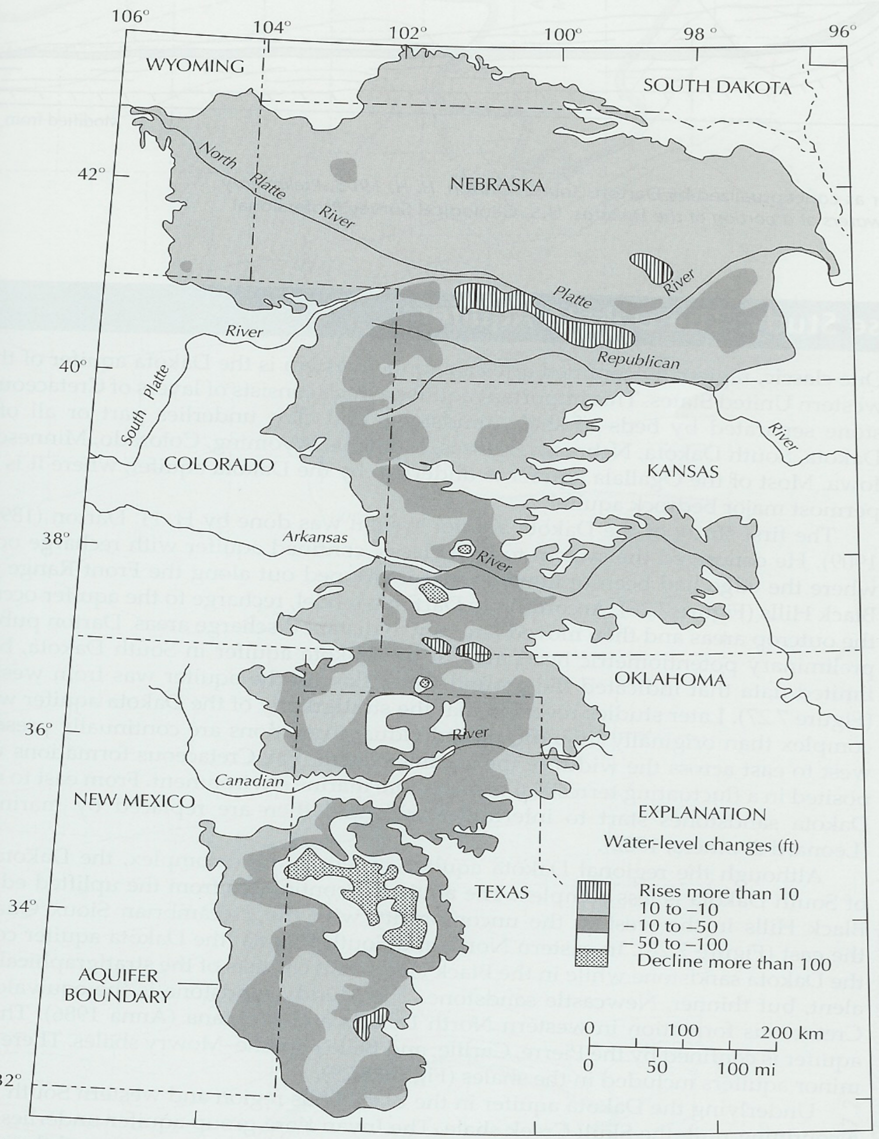
▲ FIGURE 7.23
Areal distribution of hydraulic conductivity in the High Plains aquifer. *Source: E. D. Gutentag, F. J. Heimes, N. C. Krothe, R. R. Luckey, & J. B. Weeks, U.S. Geological Survey Professional Paper 1400-B, 1984.*

Water Table in High Plains Aquifer. Fetter, Fig. 7.24



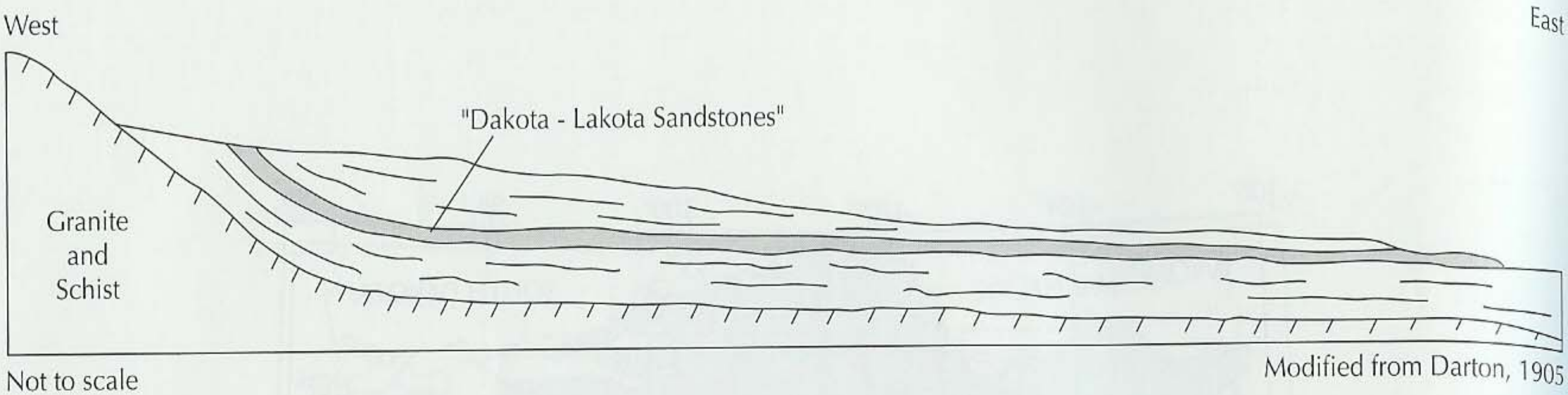
▲ FIGURE 7.24
Water table in the High Plains aquifer, 1980. *Source: E. D. Gutentag, F. J. Heimes, N. C. Krothe, R. R. Luckey, & J. B. Weeks, U.S. Geological Survey Professional Paper 1400-B, 1984.*

Water Level Changes in High Plains Aquifer. Fetter, Fig. 7.25



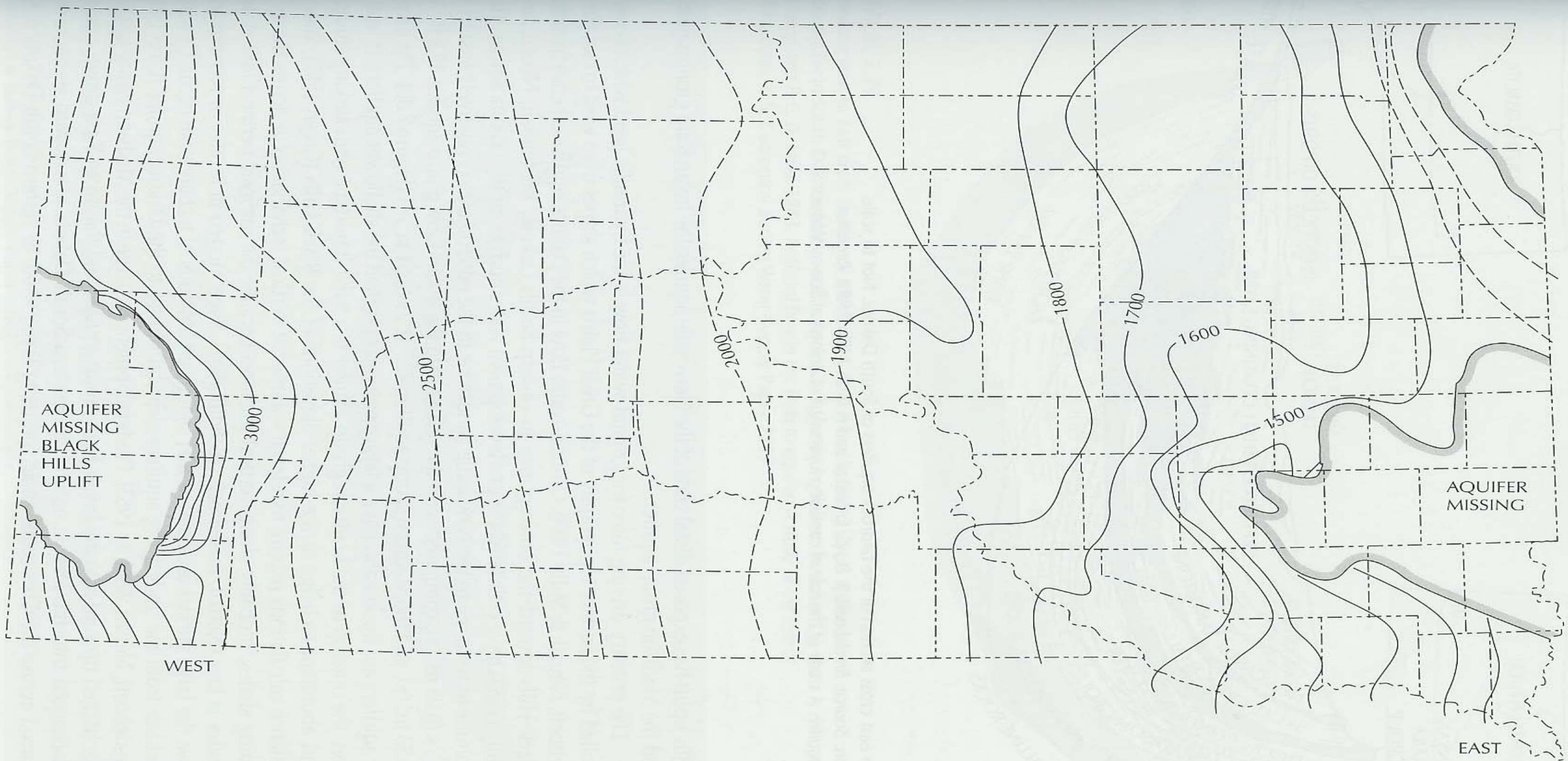
▲ FIGURE 7.25
Water-level changes in the High Plains aquifer, predevelopment to 1980. *Source: E. D. Gutentag, F. J. Heimes, N. C. Krothe, R. R. Luckey, & J. B. Weeks, U.S. Geological Survey Professional Paper 1400-B, 1984.*

The Dakota Aquifer as Conceptualized by Darton
Fetter, Fig. 7.26



▲ FIGURE 7.26
The Dakota aquifer as conceptualized by Darton. *Source: Darton, H. H. 1905. Preliminary report on artesian waters of a portion of the Dakotas.* U.S. Geological Survey Professional Paper *32.*

Predevelopment Potentiometric Surface of the Dakota Aquifer. Fetter, Fig. 7.27



▲ FIGURE 7.27
Predevelopment potentiometric surface of the Dakota aquifer in South Dakota as mapped by Darton (1909, Plate XI). *Source: Bredehoeft, J. D., C. E. Neuzil and P. C. D. Milly. 1983. Regional flow in the Dakota aquifer: A study of the role of confining layers.* U.S. Geological Survey Water Supply Paper 2237.

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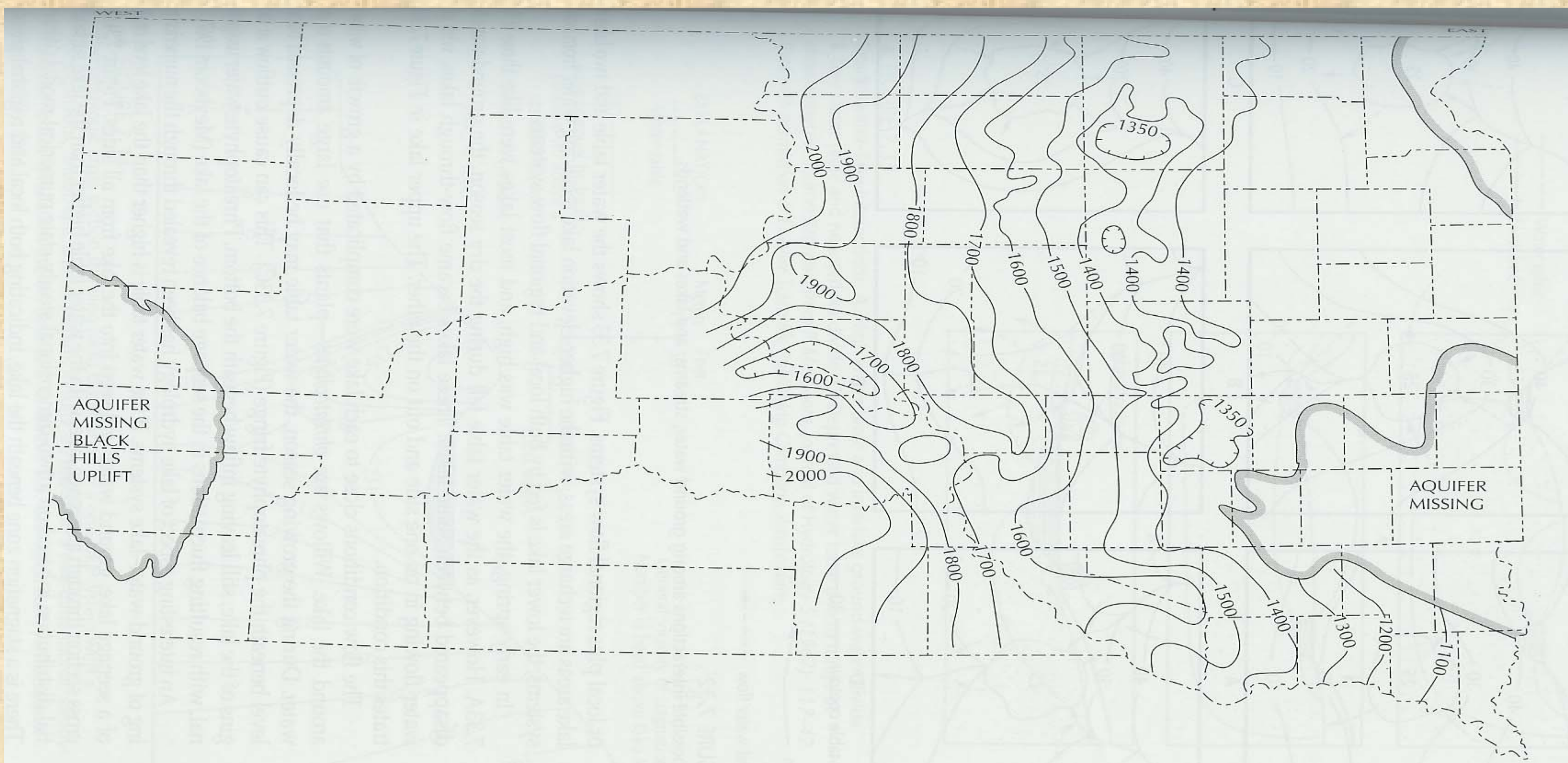
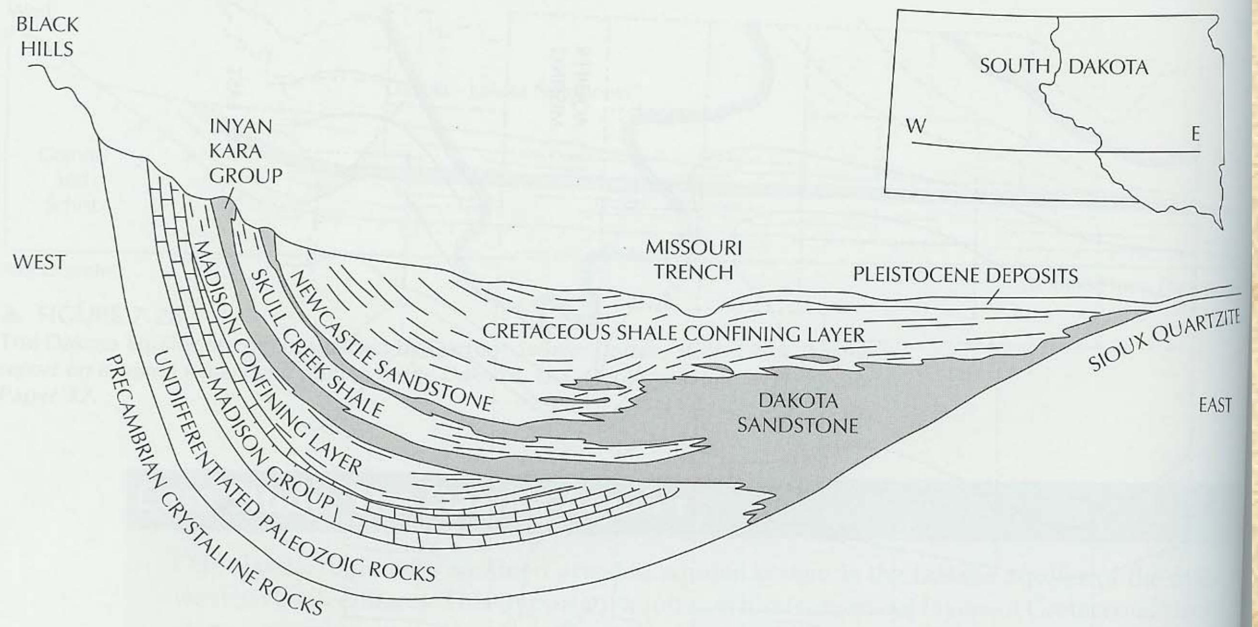
Potentiometric Surface of the Dakota Aquifer in Eastern South Dakota 1915. After 35 Years of Groundwater Development



▲ FIGURE 7.31
Potentiometric surface of the Dakota aquifer in eastern South Dakota in 1915. This was after 34 years of ground-water development. *Source: Bredehoeft, J. D., C. E. Neuzil and P. C. D. Milly. 1983. Regional flow in the Dakota aquifer: A study of the role of confining layers.* U.S. Geological Survey Water Supply Paper *2237*.

Generalized West to East Cross Section of the Bedrock Aquifers of South Dakota. Fetter, Fig. 7.28

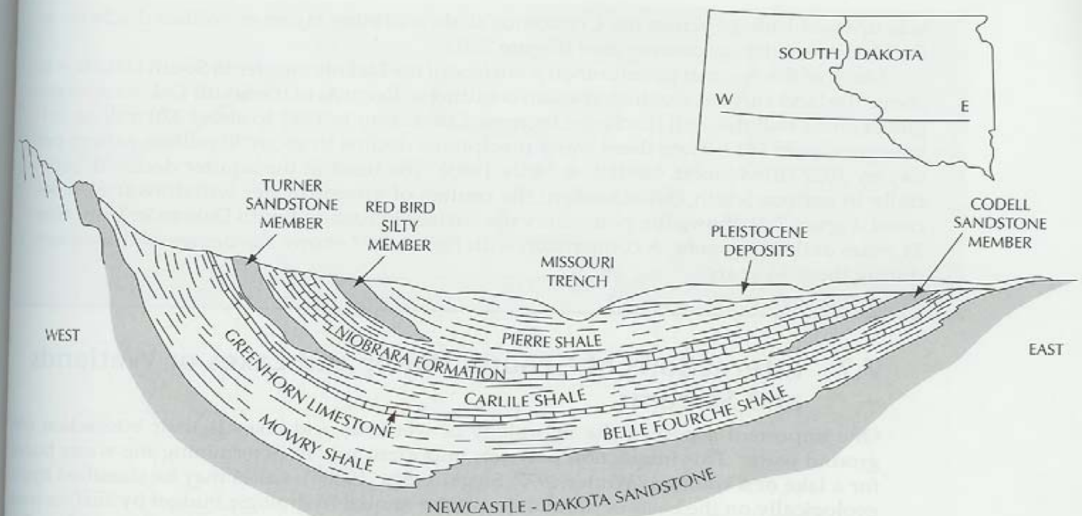


▲ FIGURE 7.28

Generalized west to east cross section of the bedrock aquifers of South Dakota. Not to scale, vertical exaggeration. *Source: Bredehoeft, J. D., C. E. Neuzil and P. C. D. Milly. 1983. Regional flow in the Dakota aquifer: A study of the role of confining layers.* U.S. Geological Survey Water Supply Paper *2237.*

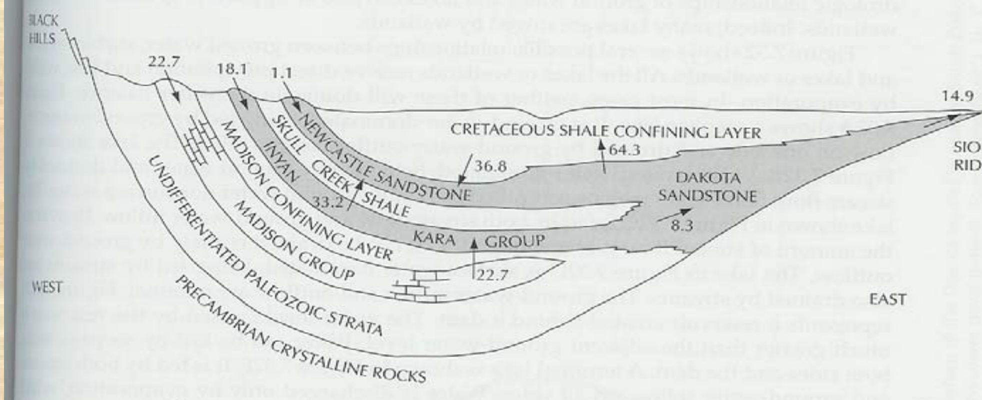
Cross Section of the upper Cretaceous Confining Layer above Dakota Aquifer.

Predevelopment Steady State Groundwater Flow



▲ FIGURE 7.29

Generalized west to east cross section of the upper Cretaceous confining layers above the Dakota aquifer in South Dakota. Not to scale, vertical exaggeration. *Source: Bredehoeft, J. D., C.E. Neuzil and P. C. D. Milly. 1983. Regional flow in the Dakota aquifer: A study of the role of confining layers.* U.S. Geological Survey Water Supply Paper 2237.



▲ FIGURE 7.30

Computed pre-development steady state ground water flows in cubic feet per second through the bedrock aquifers of South Dakota. *Source: Bredehoeft, J. D., C. E. Neuzil and P. C. D. Milly. 1983. Regional flow in the Dakota aquifer: A study of the role of confining layers.* U.S. Geological Survey Water Supply Paper 2237.

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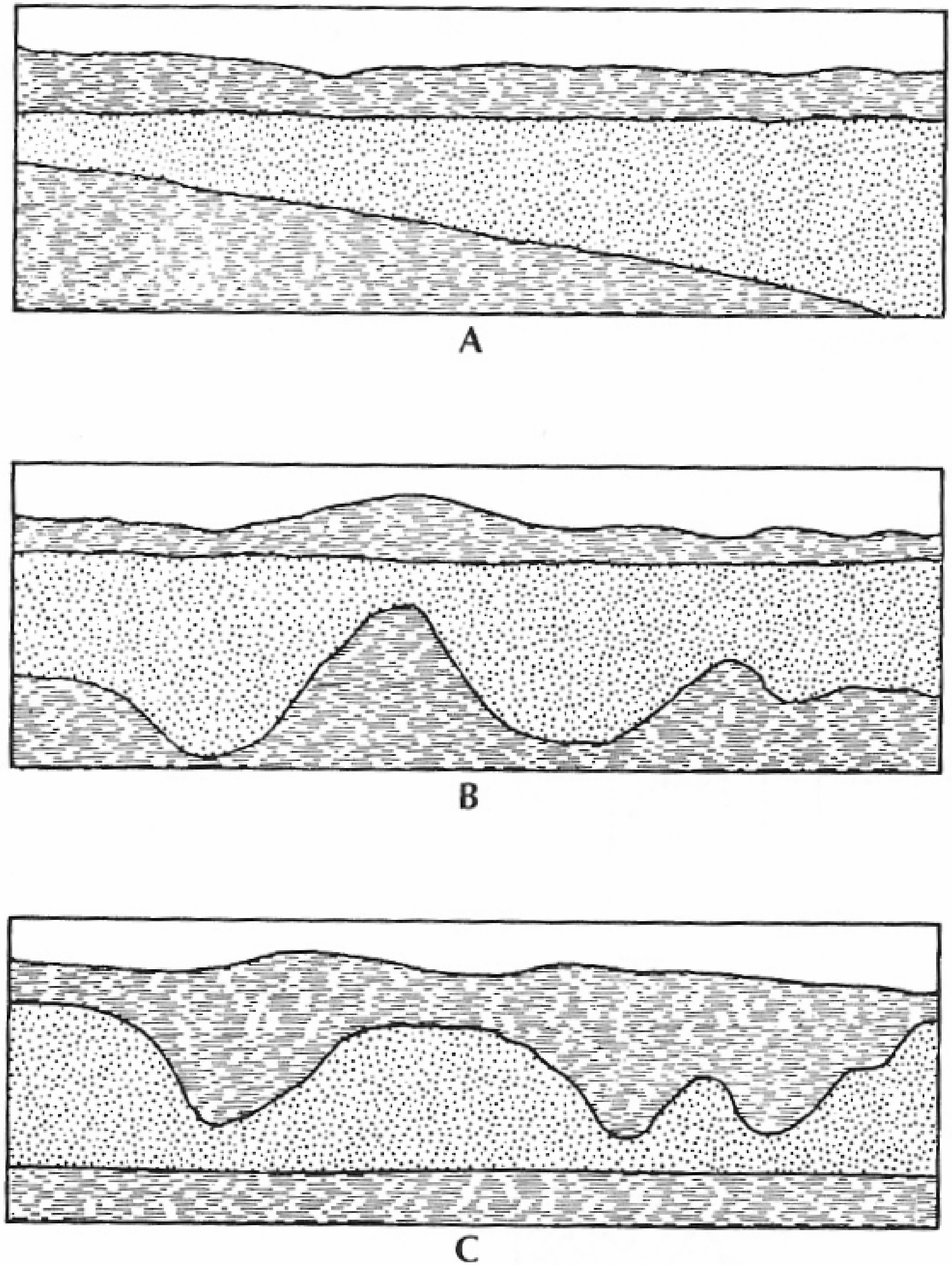

Figure 8.21. Sedimentary conditions producing a sandstone aquifer of variable thickness: A. Sandstone deposited in a sedimentary basin. B. Sandstone deposited uncomfortably over an erosional surface. C. Surface of sandstone dissected by erosion prior to deposition of overlying beds.

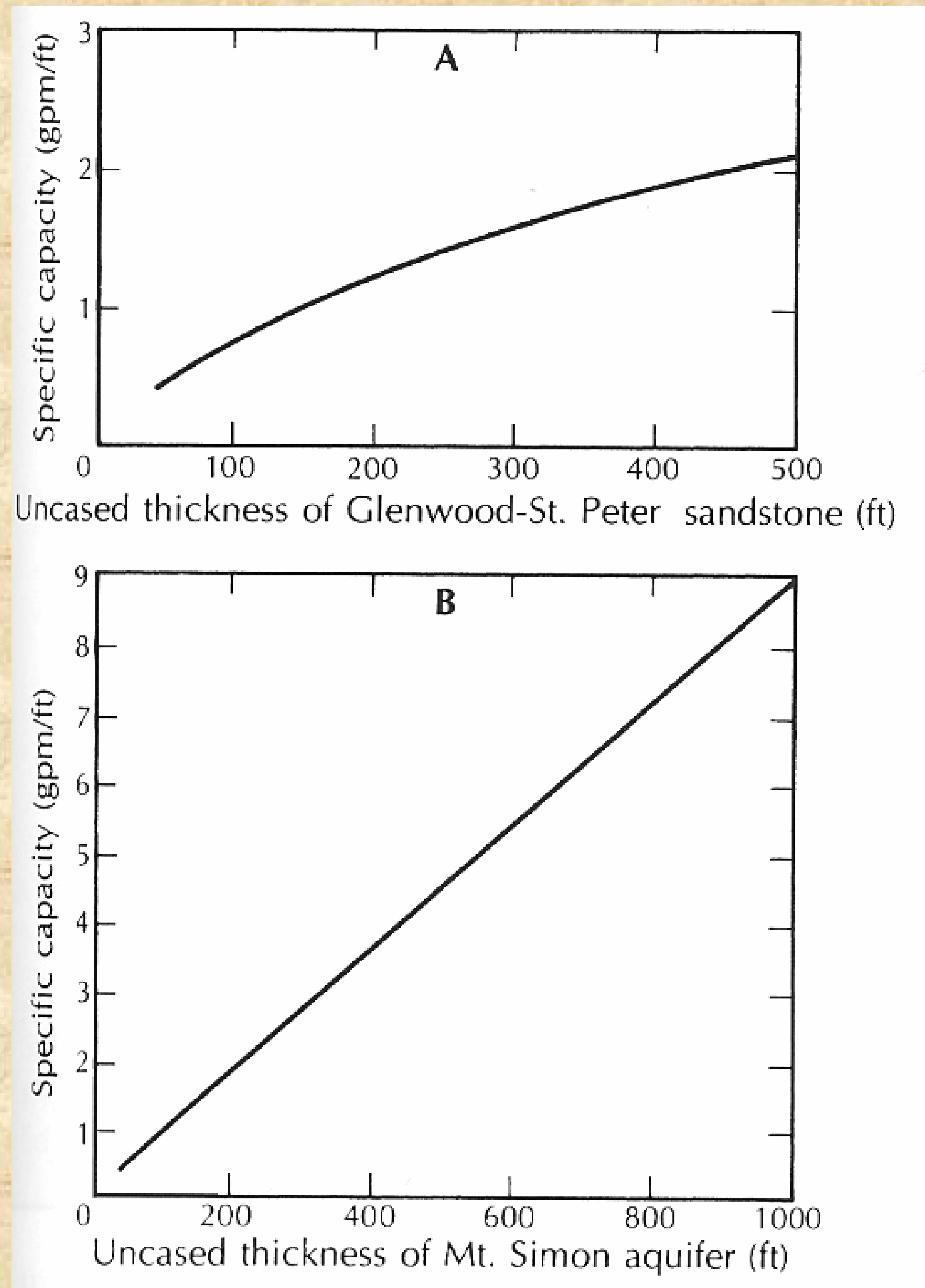

Figure 8.22. Relation between the specificity capacity of a well (gallons per minute of yield per foot of drawdown) and the uncased thickness of the sandstone aquifer: A. Glenwood-St. Peter sandstone. B. Mt. Simon Sandstone. Both of northern Illinois.

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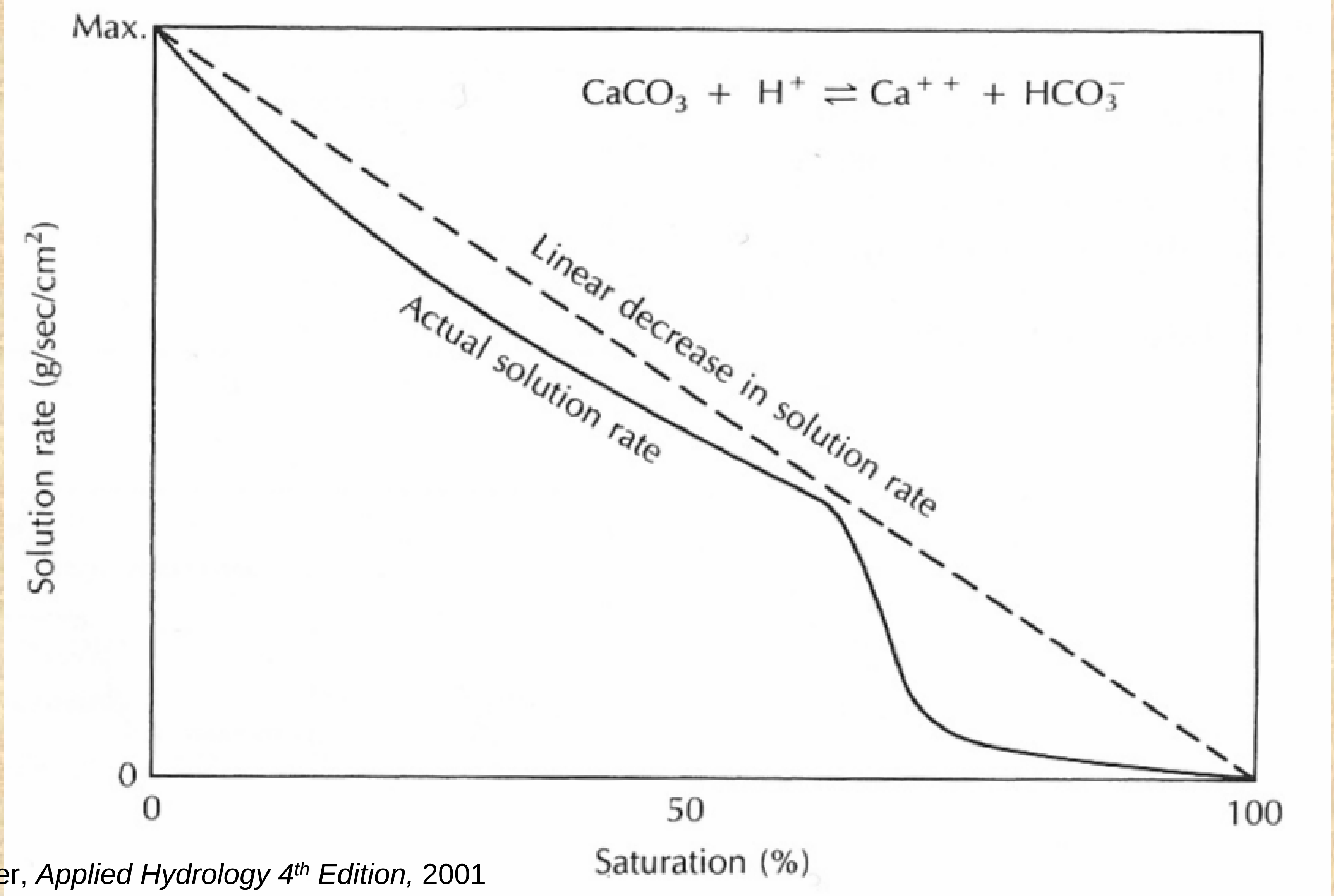
Figure 8.23. Solution rate vs. degree of saturation. Instead of decreasing linearly, the solution rate drops sharply to a low level at 65-90% saturation.



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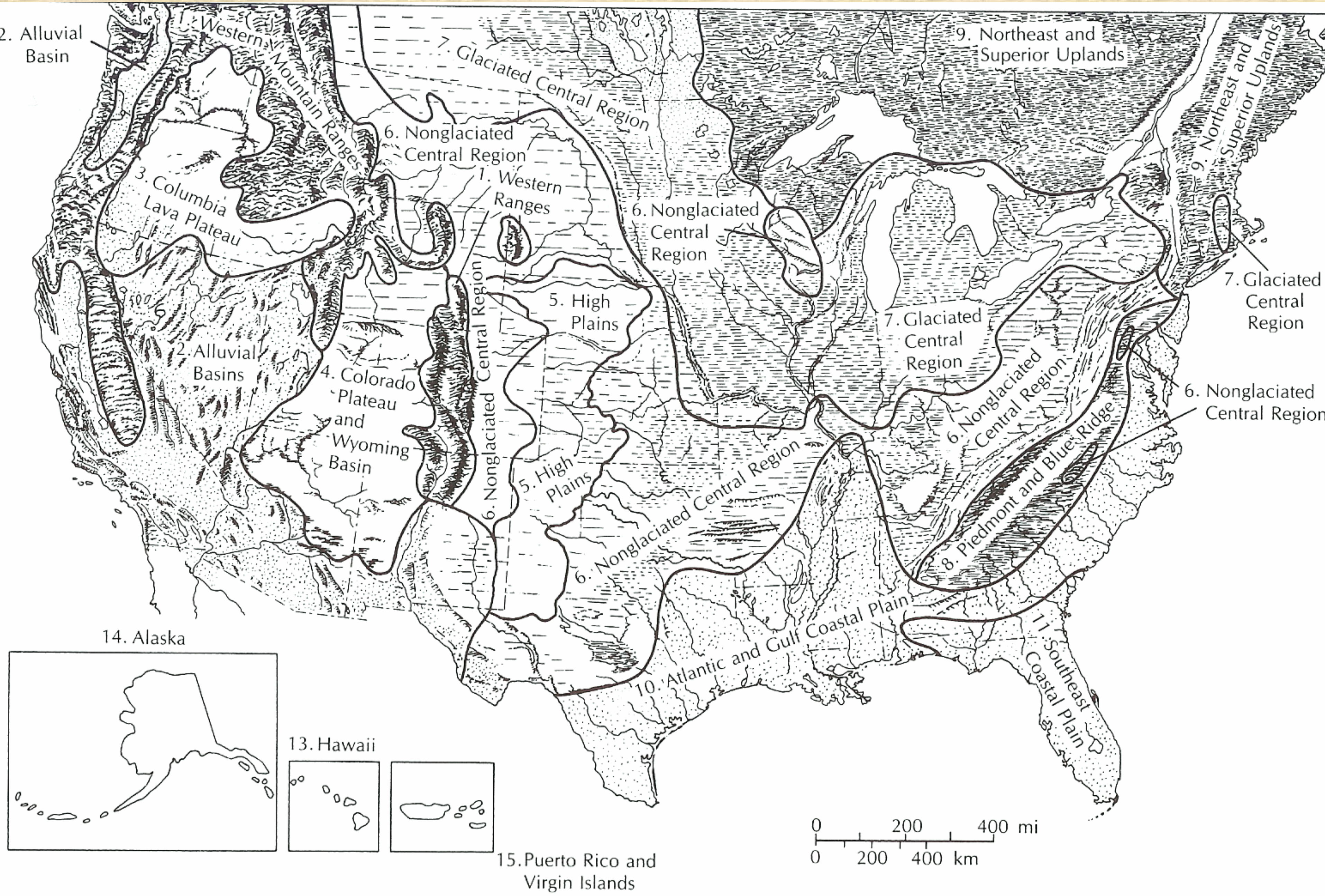

Figure 8.24. Growth of a carbonate aquifer drainage system starting in the recharge area and growing toward the discharge are. A. At first, most joints in the recharge area undergo solution enlargement. B. As the solution passages grow, they join and become fewer. C. Eventually one outlet appears at the discharge zone.

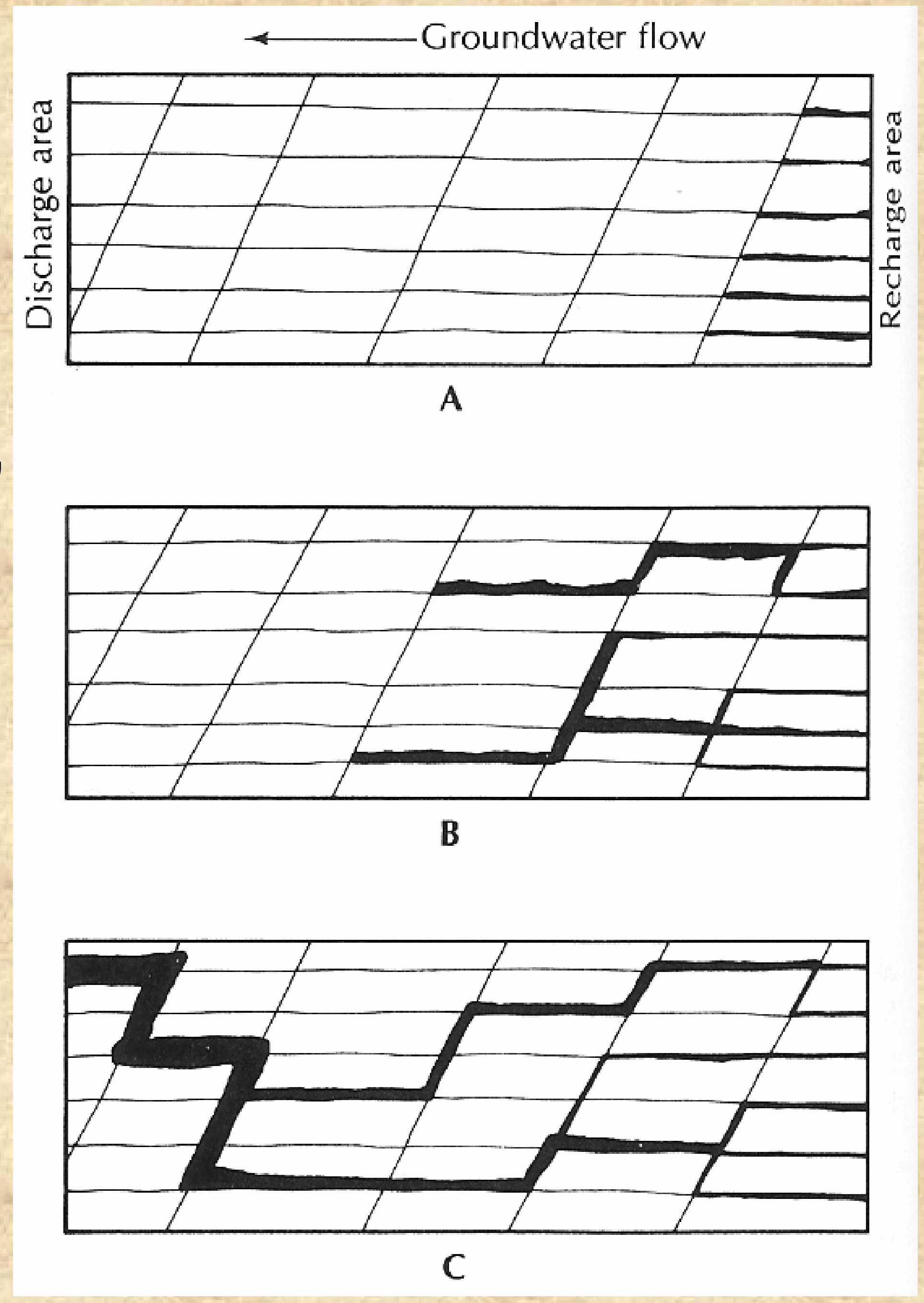

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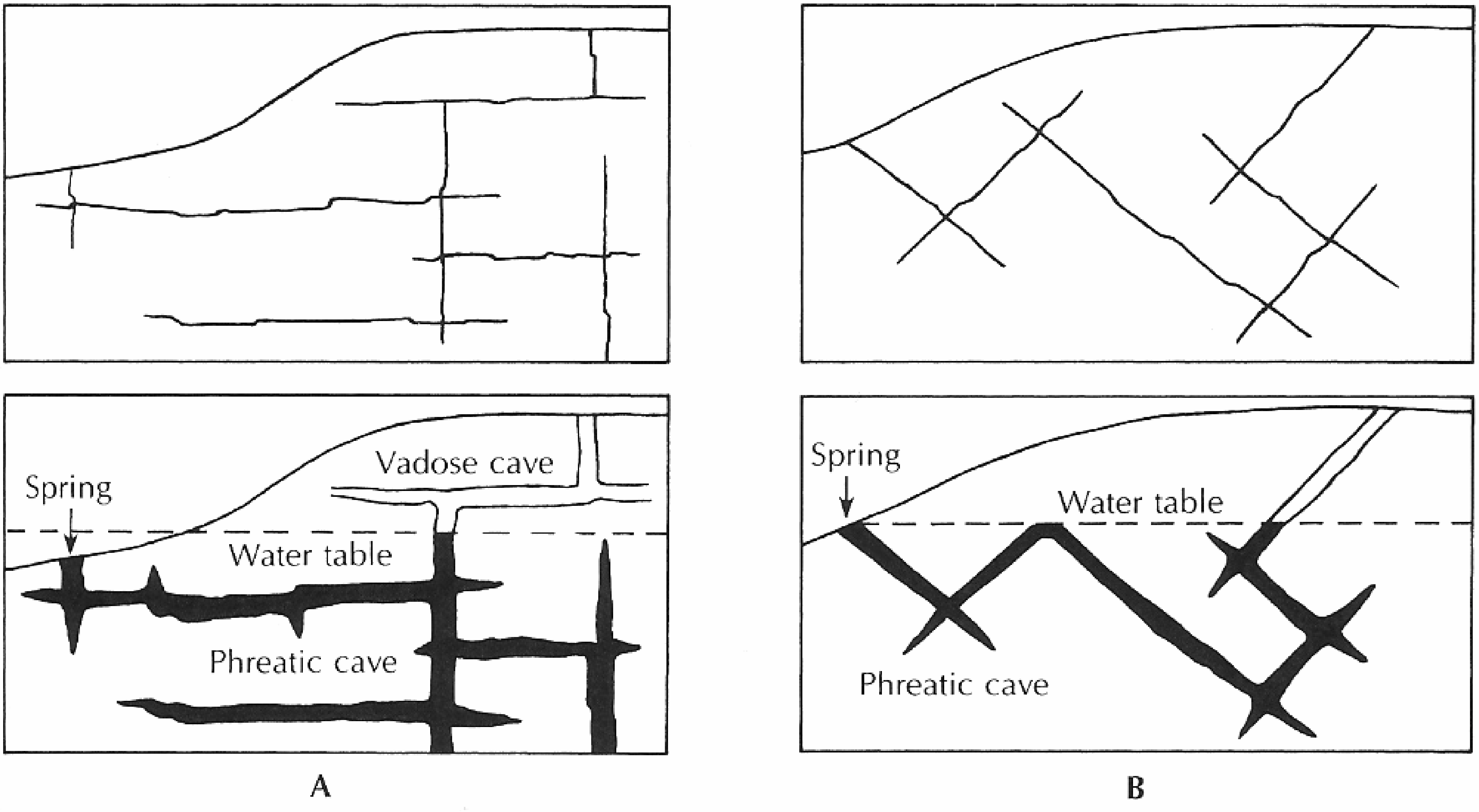
Figure 8.25. Effects of fissure density and orientation on the development of cavers.



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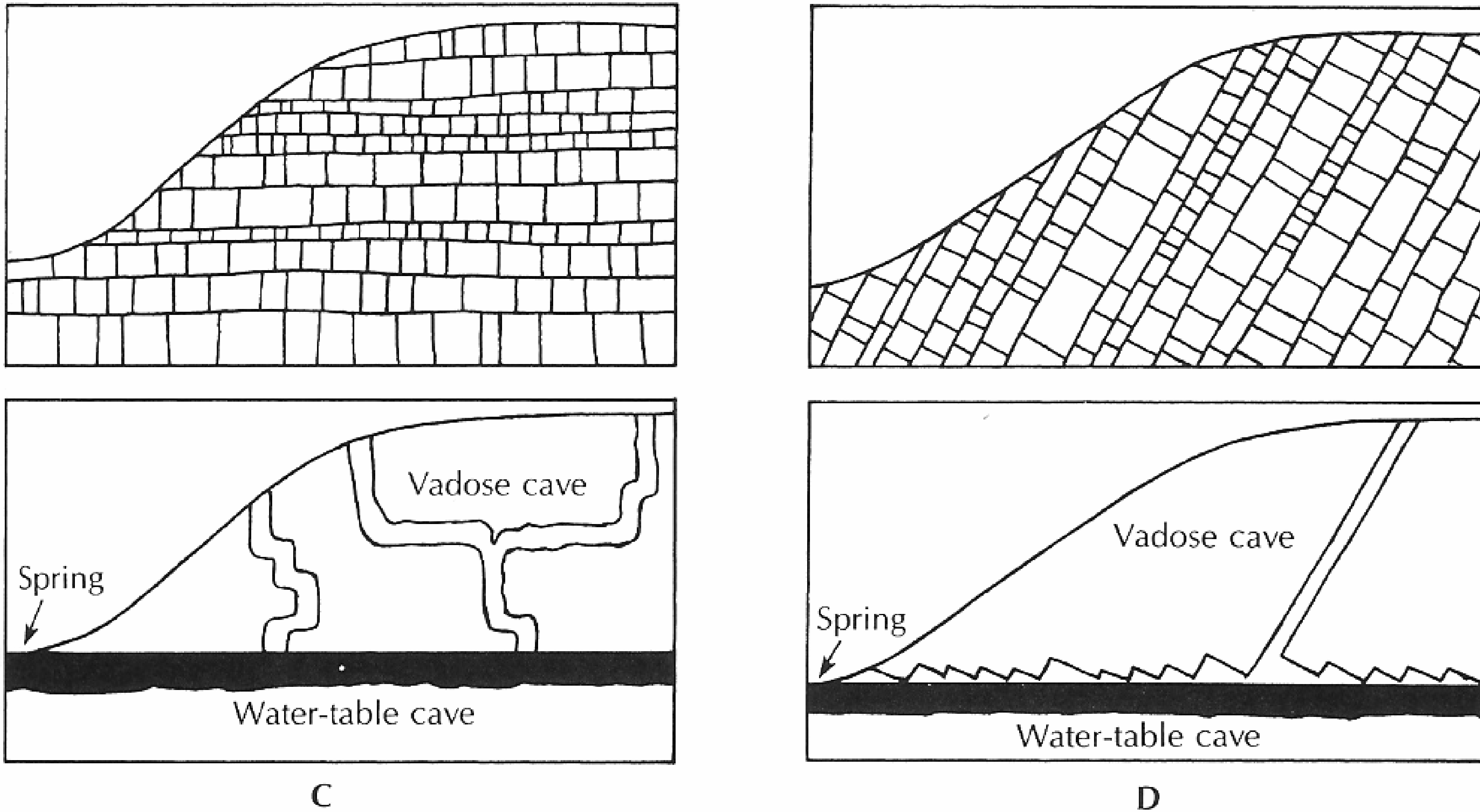

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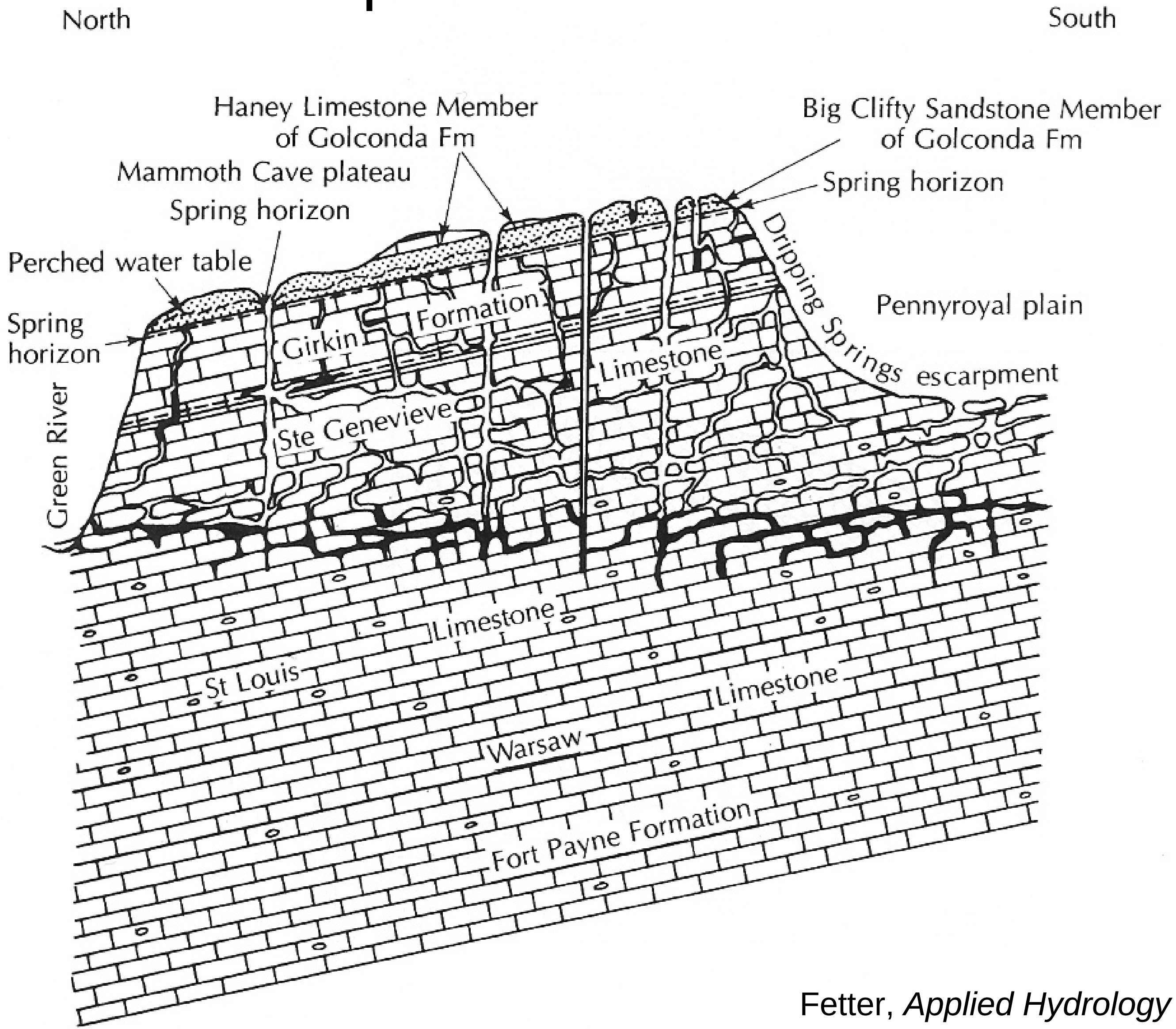
Figure 8.26. Diagrammatic cross section through the Mammoth Cave Plateau. Groundwater flow in the carbonate aquifer is from south to north.



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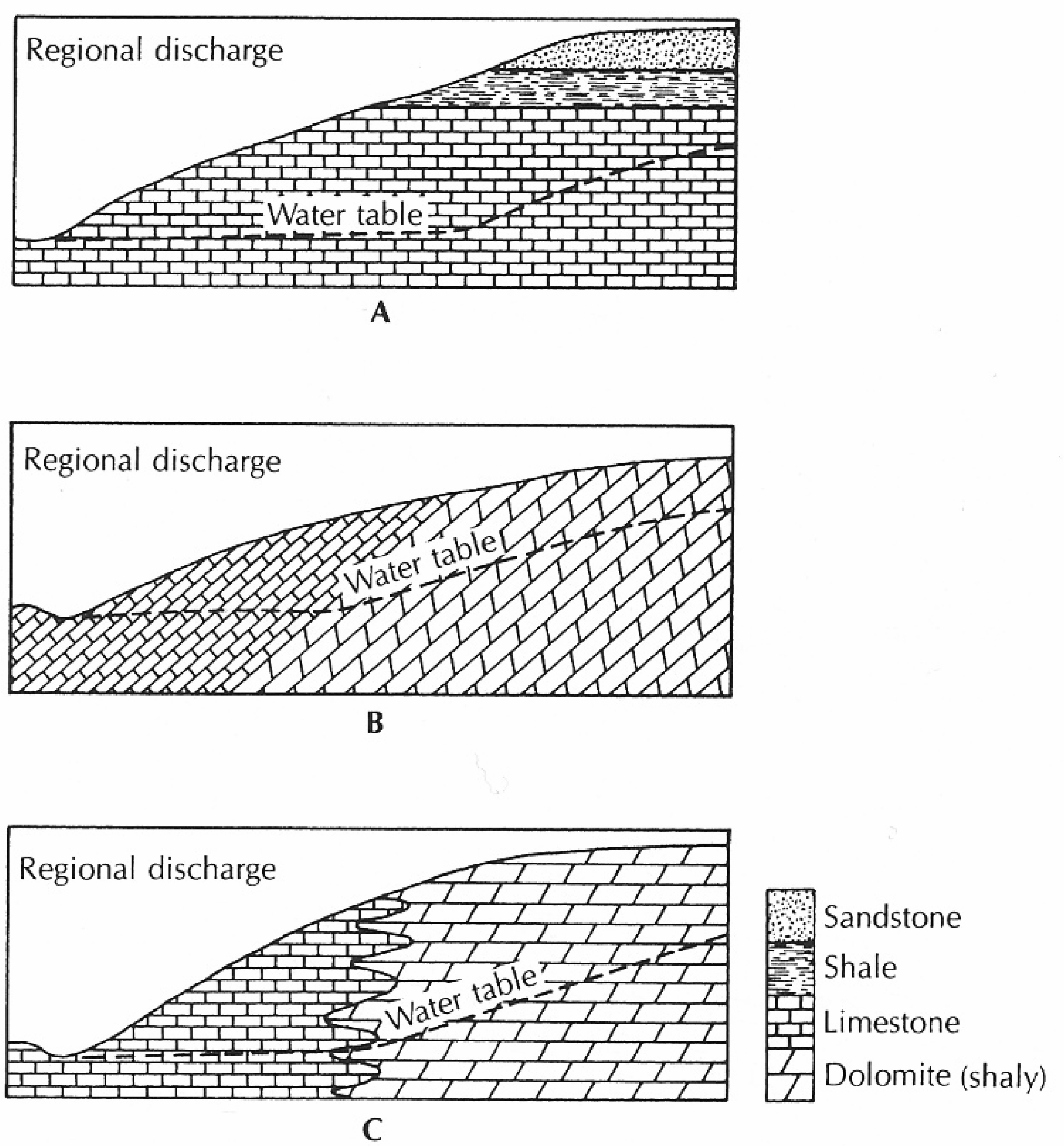

Figure 8.27. Geologic conditions resulting in a difference in hydraulic conductivity and, hence, a difference in the water-table gradient.

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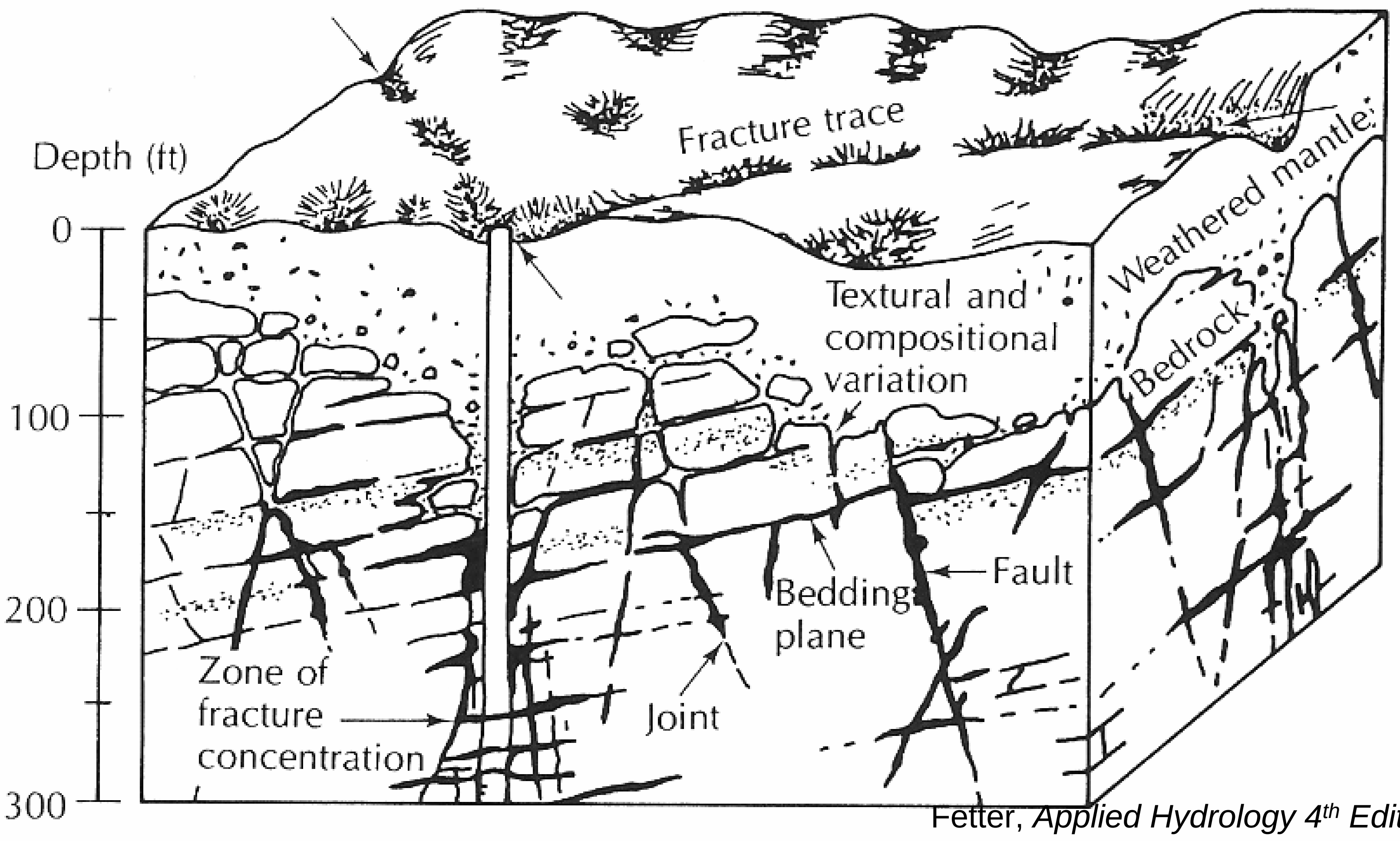
Table 8.28. Concentration of ground water along zones of fracture concentrations in carbonate rock. Wells that do not intercept an enlarged fracture or a bedding plane may be dry, thus indicating a discontinuous water table.



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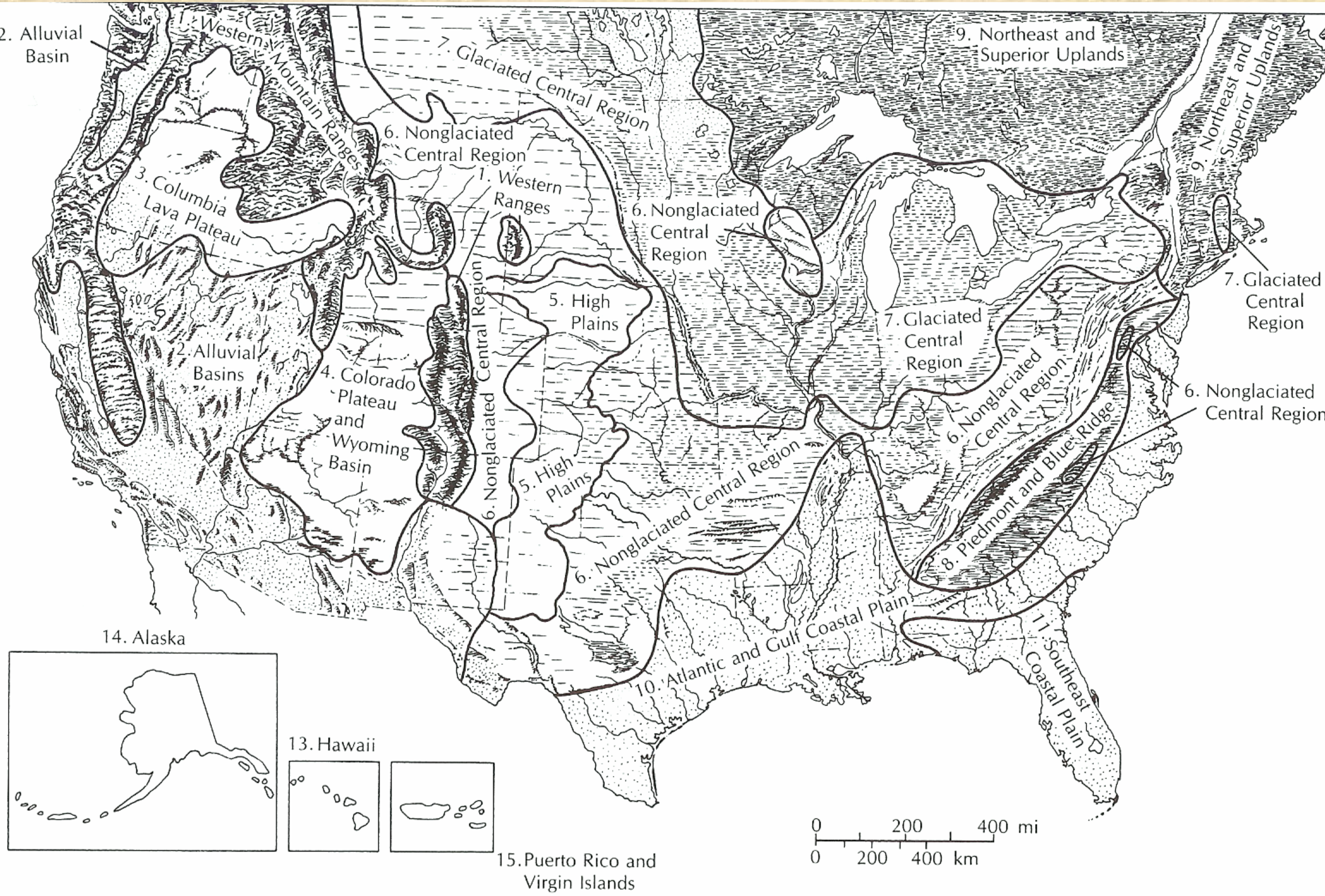


Approximate Extent of Regional Aquifers in the Southeastern United States. Fetter, Fig. 7.17

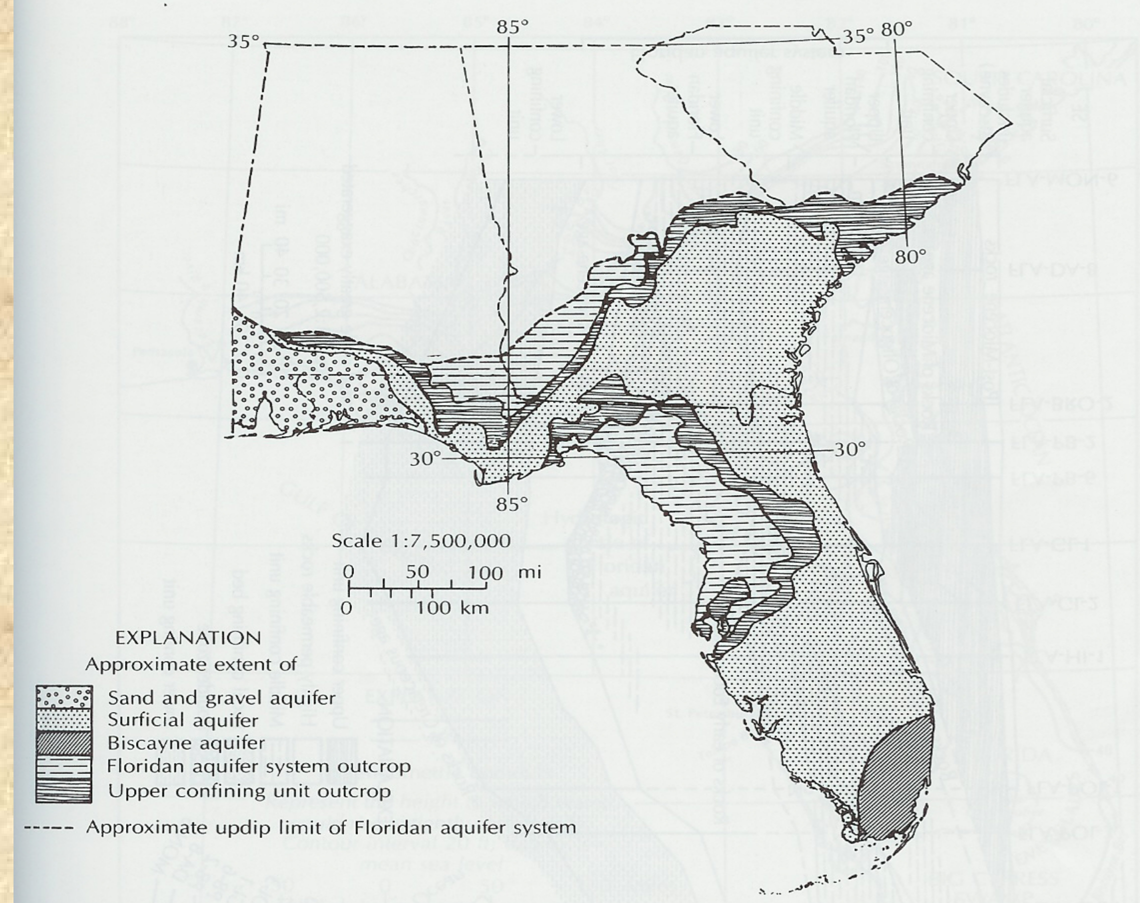
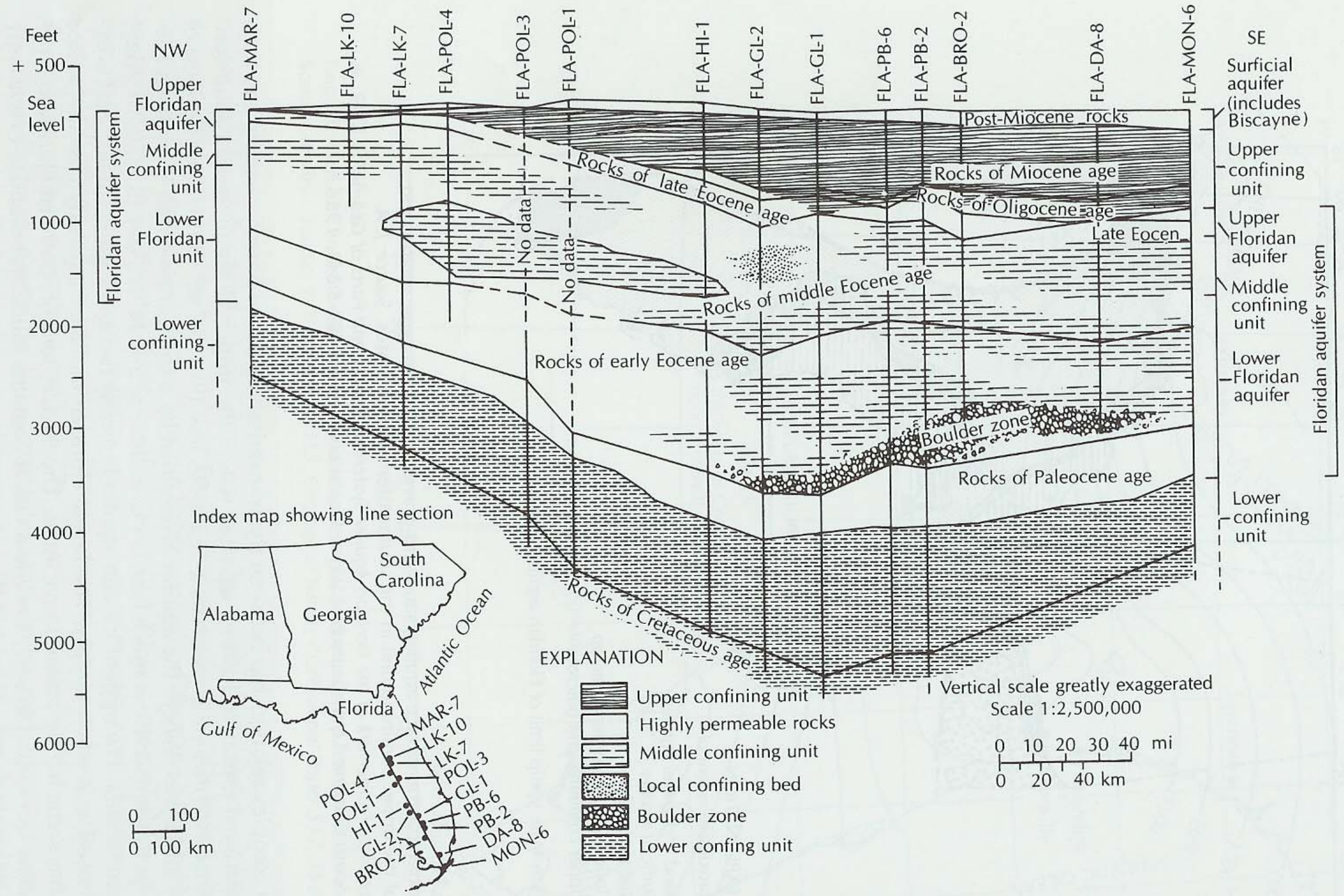


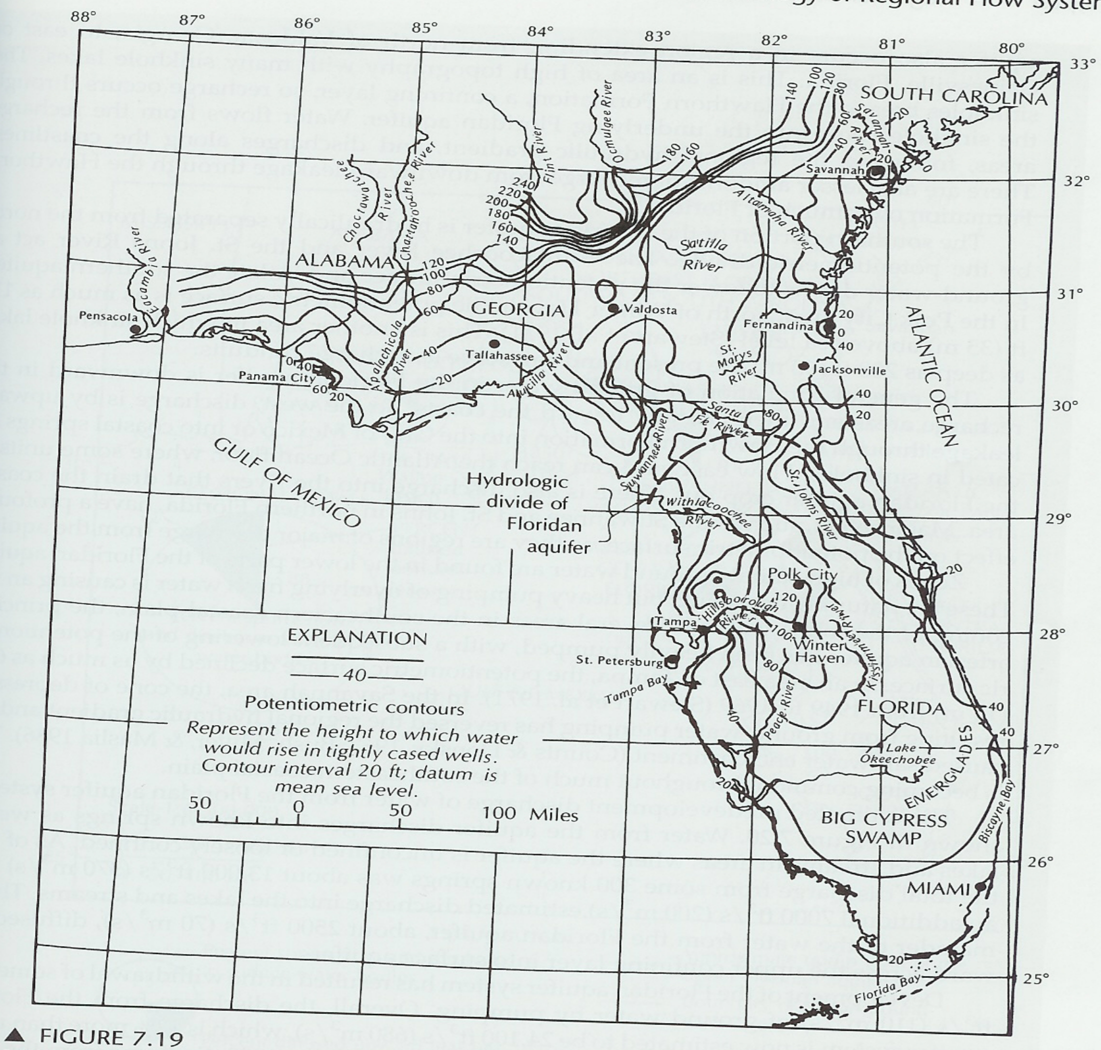
FIGURE 7.17
pproximate extent of the surface aquifer, sand-and-gravel aquifer, Biscayne aquifer, and
tcrop area of the upper confining unit in the southeastern United States. *Source: J. A.
iller, "Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Georgia,
abama, and South Carolina." U.S. Geological Survey Professional Paper 1403-B:B41, 1986.*

Hydrogeologic cross section from Monroe to Marion County Florida. Fetter, Fig 7.18



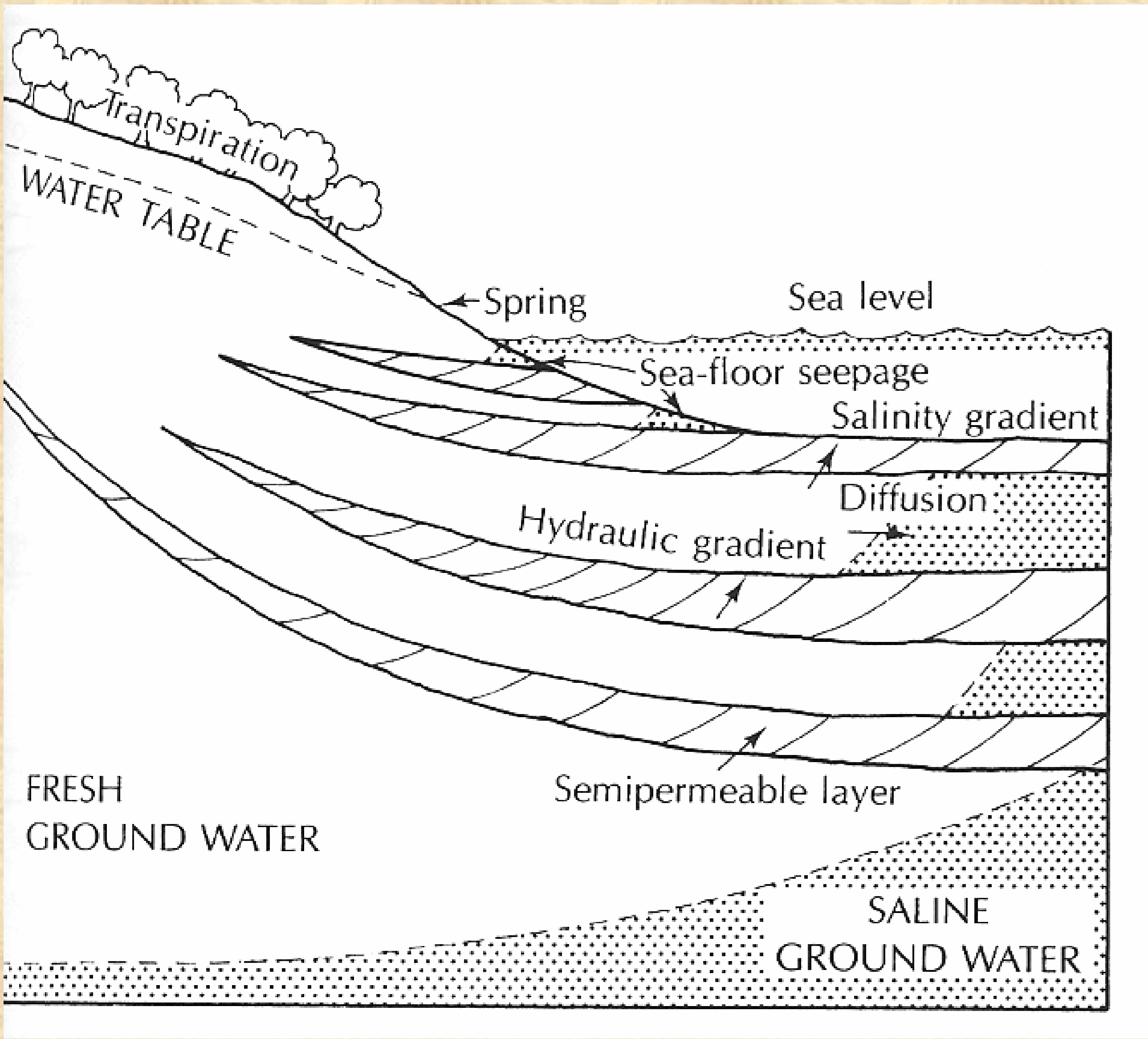
▲ FIGURE 7.18 Generalized hydrogeologic cross section from Monroe County to Marion County, Florida. *Source: J. A. Miller, "Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Georgia, Alabama and South Carolina." U.S. Geological Survey Professional Paper 1403-B:B78, 1986.*

Potentiometric Surface of Principal Artesian Aquifer of the Southeastern United States. Fetter, Fig. 7.19



▲ FIGURE 7.19
Potentiometric surface of water in the principal artesian aquifer of the southeastern United States. *Source: V. T. Stringfield, U.S. Geological Survey Professional Paper 517, 1966.*

Figure 8.33. Typical fresh-water-salt-water relationship in a layered coastal aquifer



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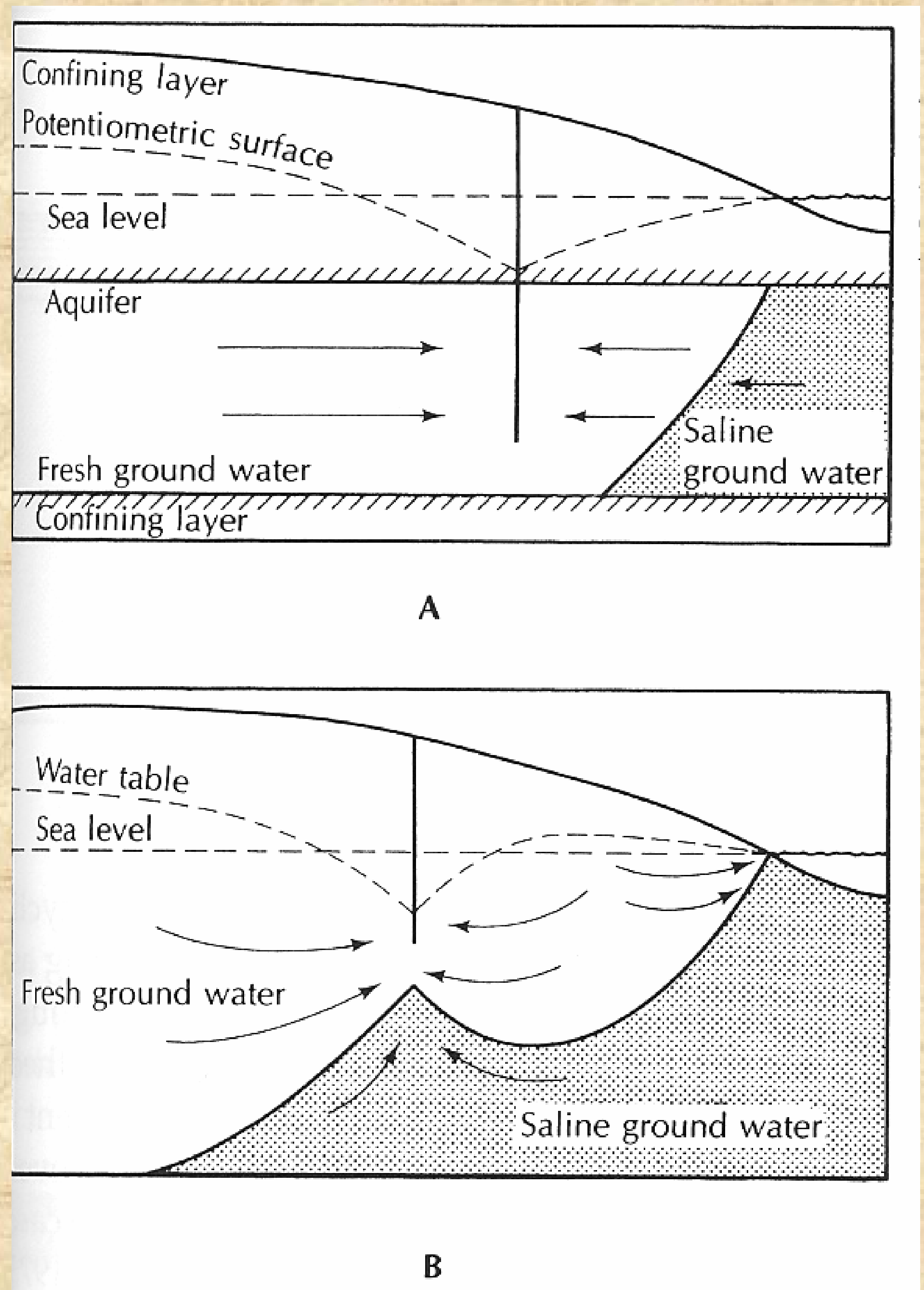

Figure 8.35. Active saline-water encroachment in a confined aquifer with the potentiometric surface below sea level. B. Active saline-water encroachment in an unconfined aquifer with the water table drawn below sea level.

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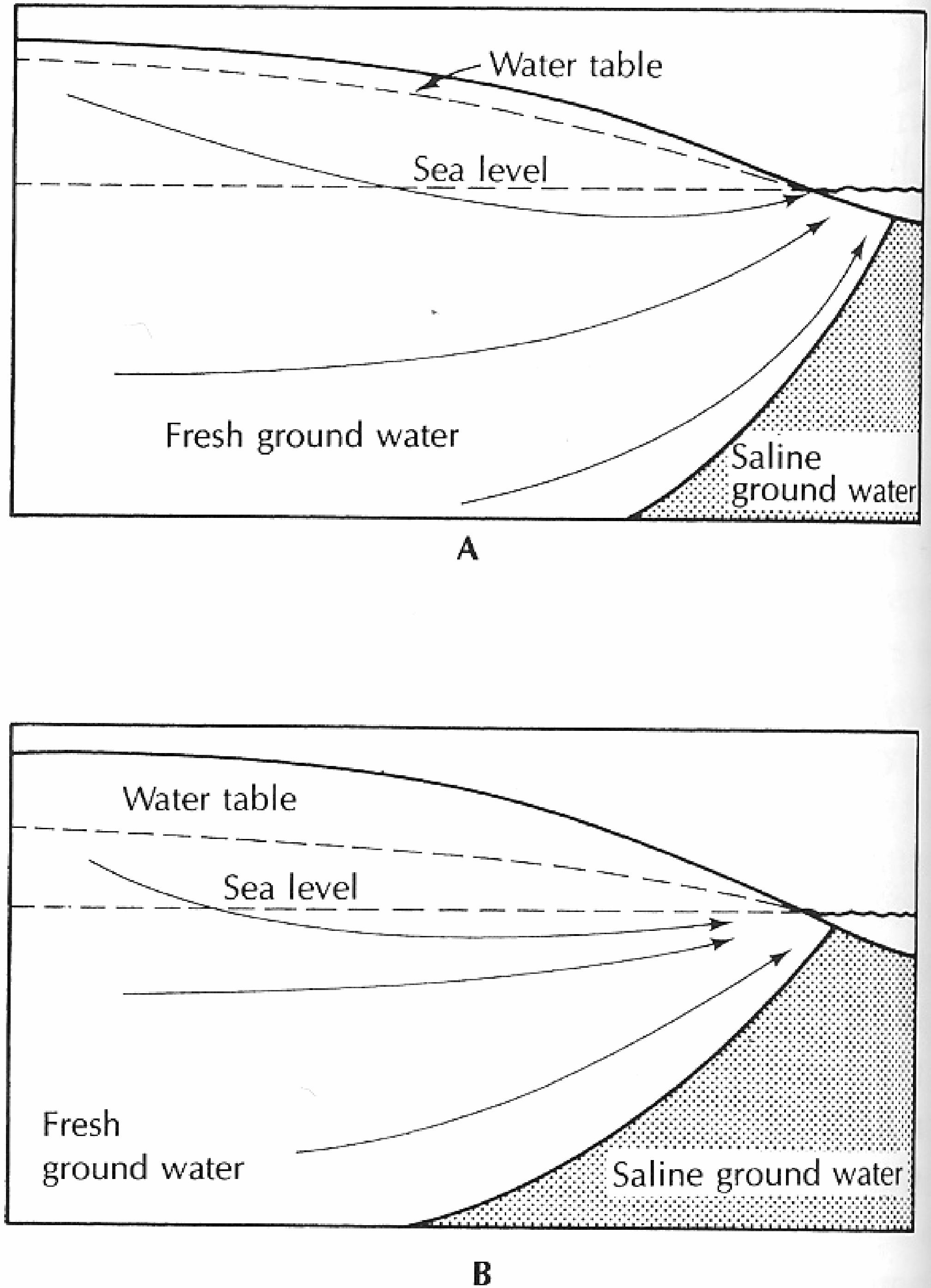

Figure 8.34. A. Unconfined coastal aquifer under natural ground-water discharge conditions. B. Passive saline-water encroachment due to a general lowering of the water table. Flow in the fresh-water zone is still seaward.

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Figure 8.36. Circulation of fresh and saline ground water at a zone of diffusion in a coastal aquifer.

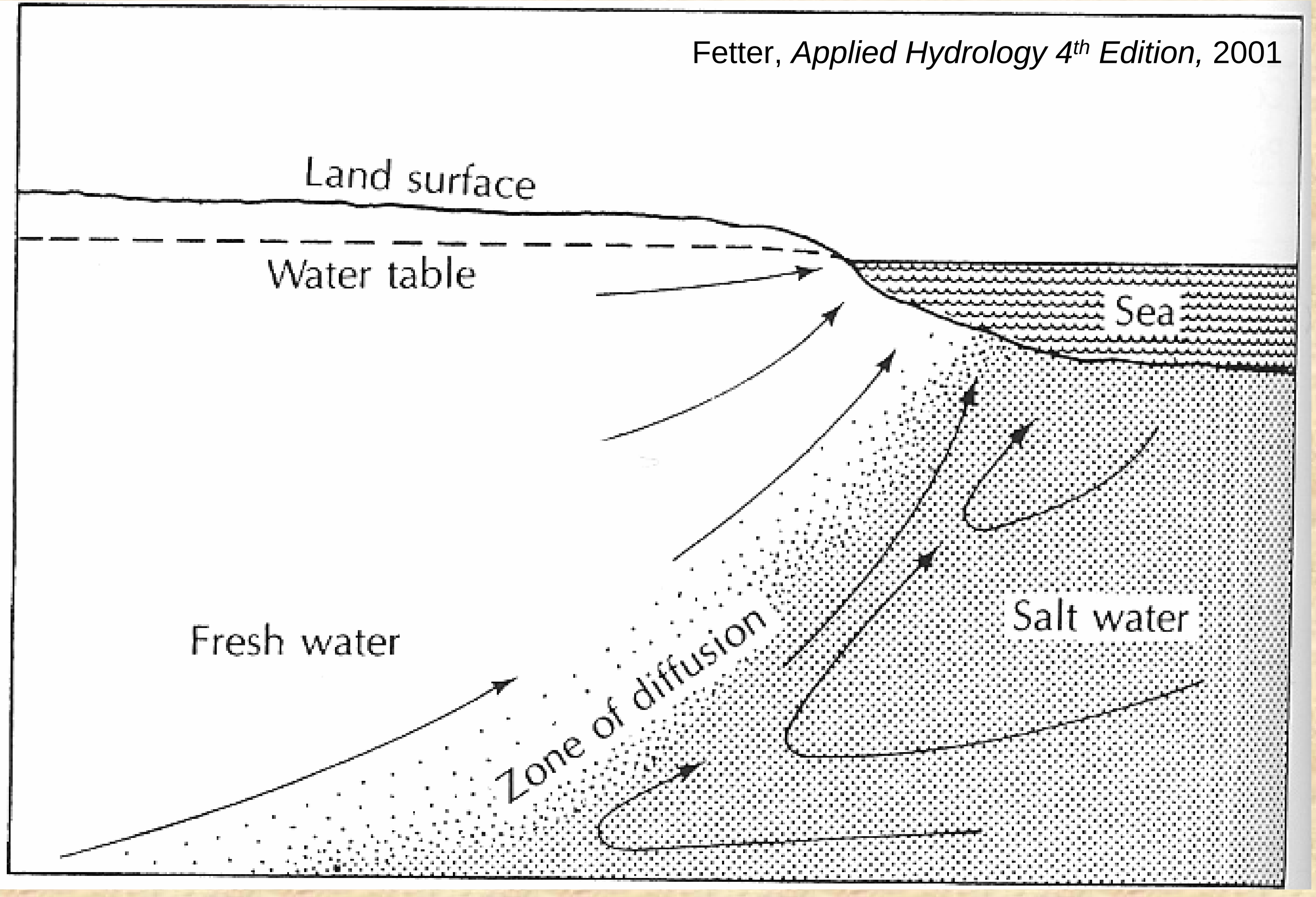
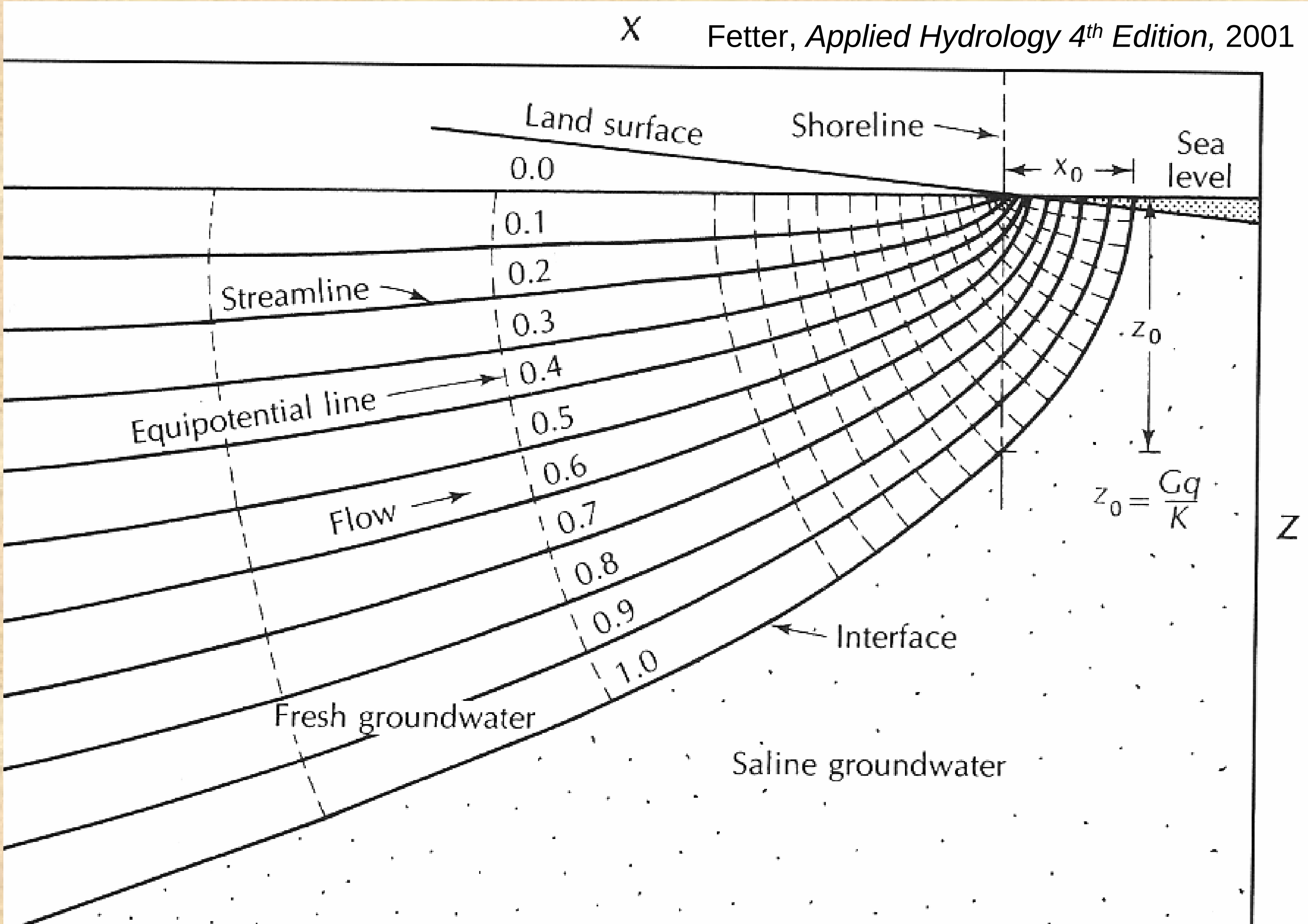


Figure 8.39. Flow pattern near a beach as computed using Equation 8.5.



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