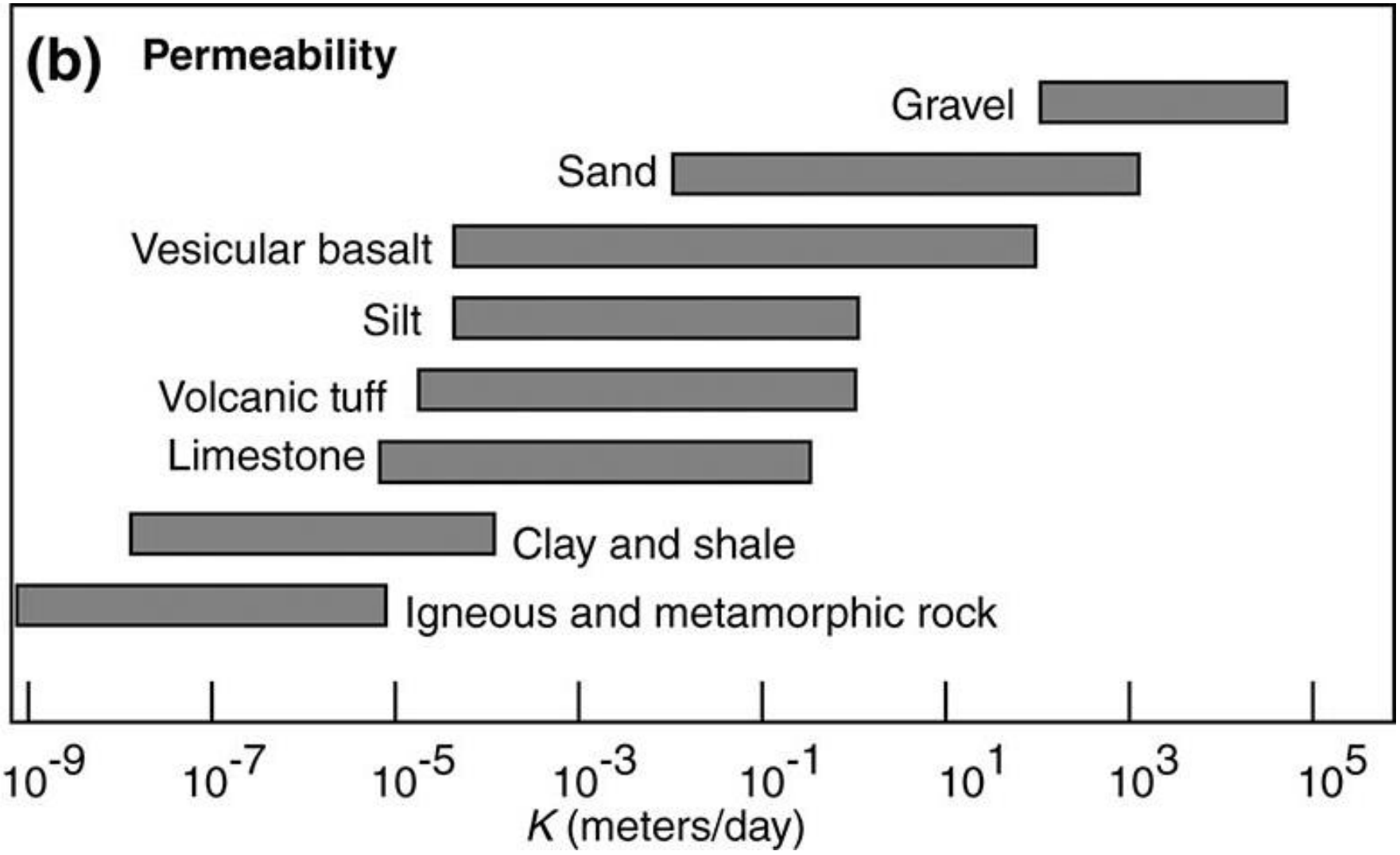
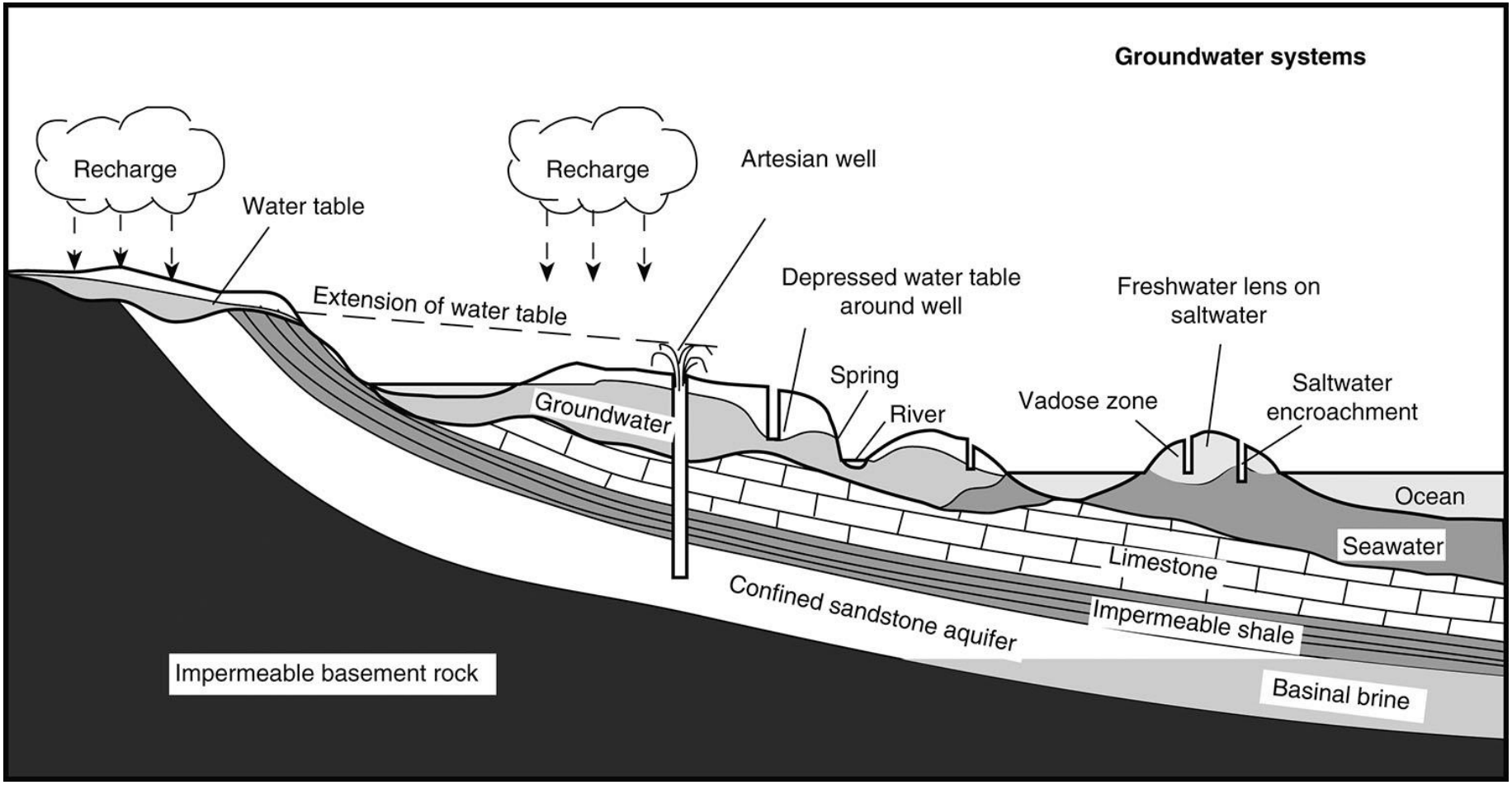
Where do Minerals concentrate *within* the crust? (Ch.2)

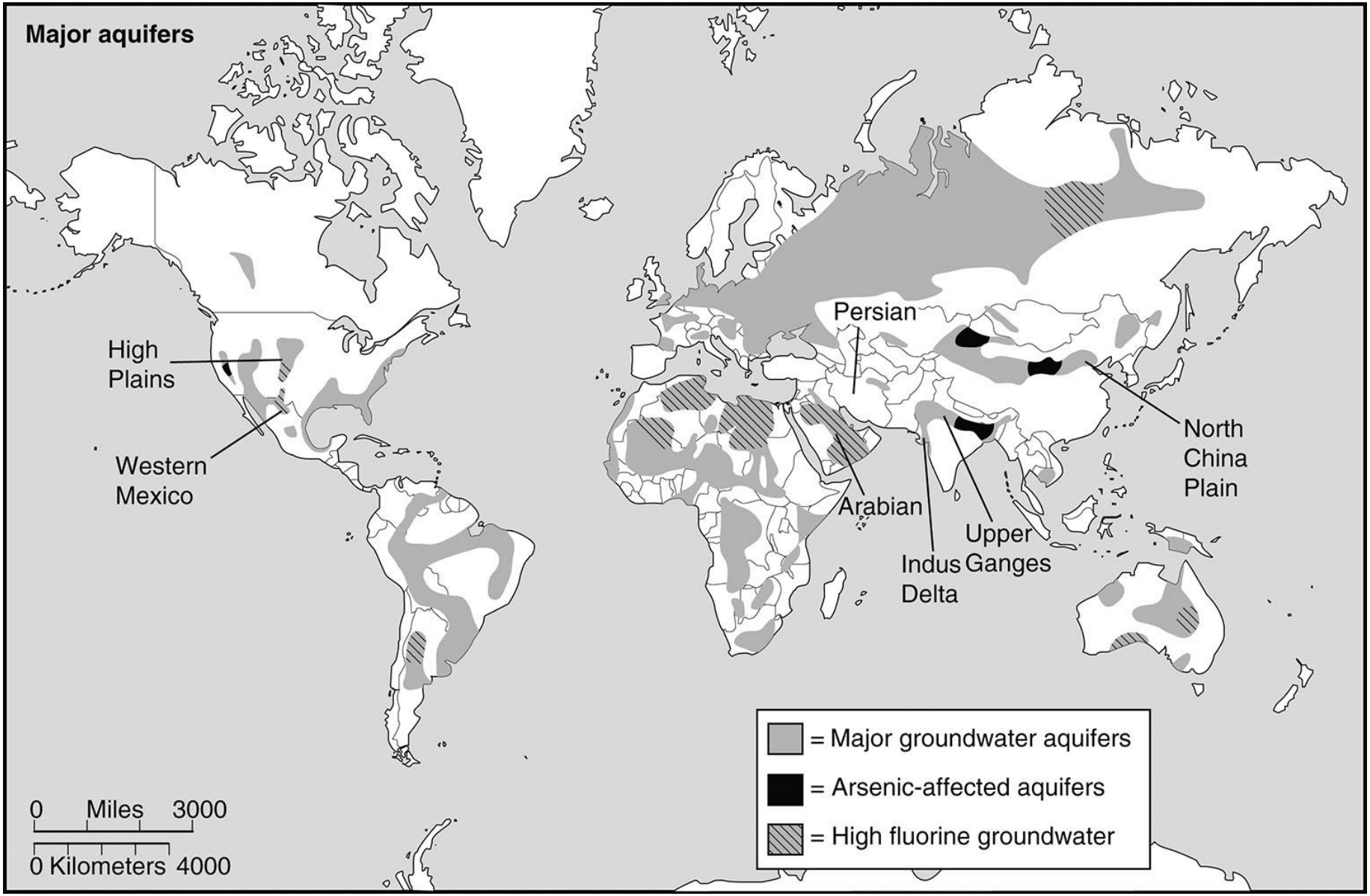
1. Soil (through weathering)
2. Groundwater
3. Magmatic / Metamorphic processes

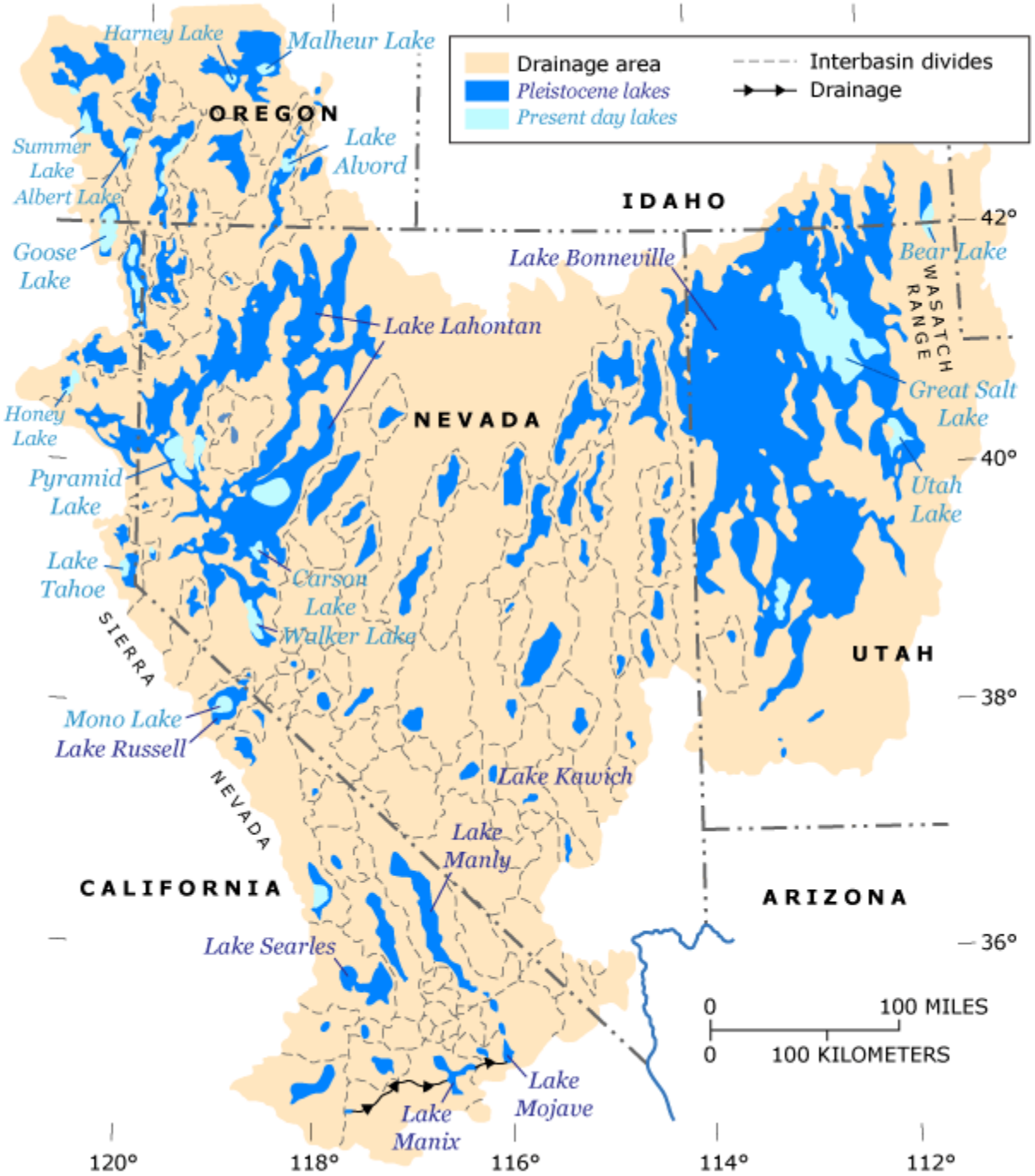
Question:

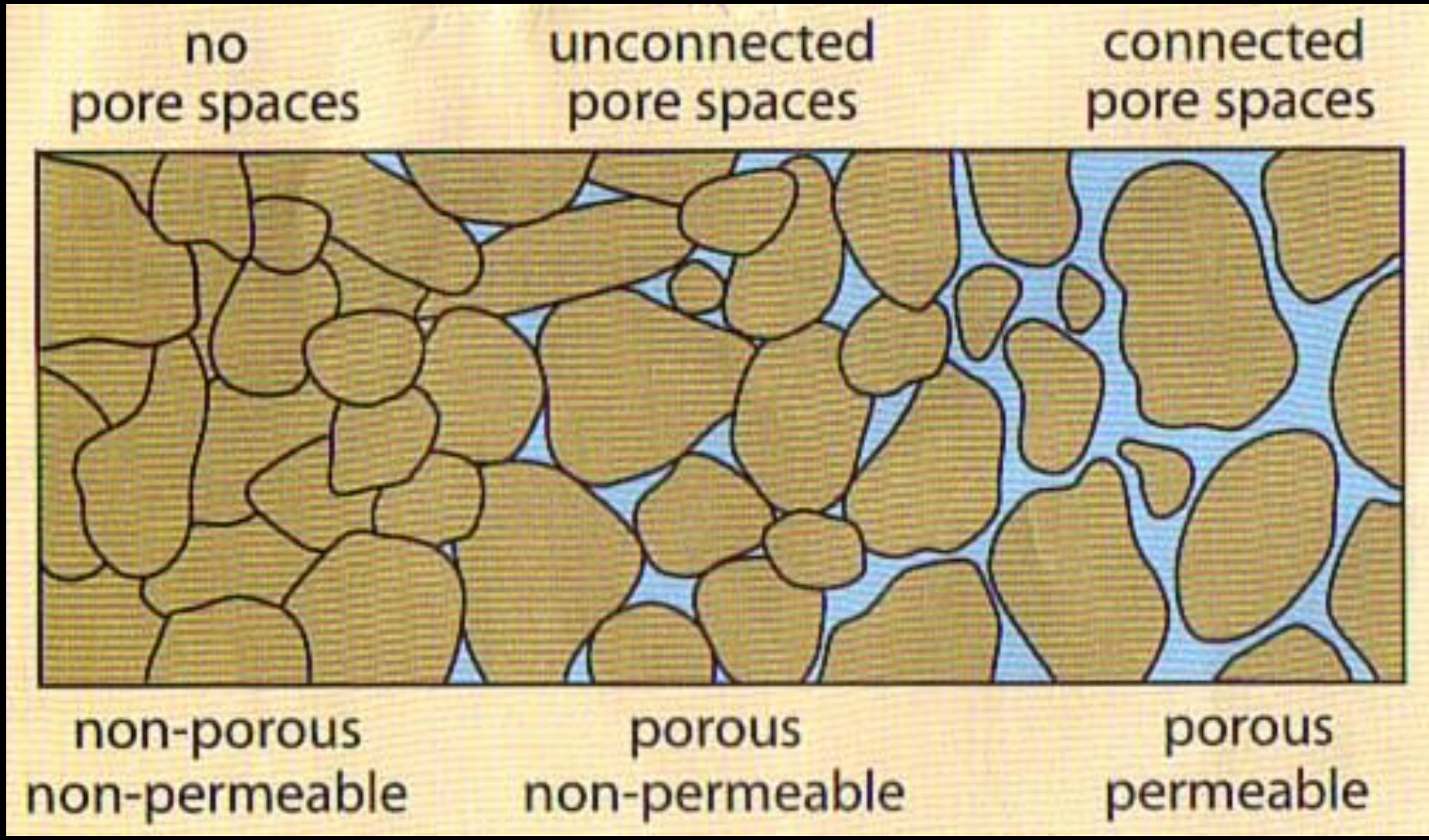
Although mineral deposits are forming today by natural geologic processes, we refer to them as "non-renewable resources." Why?


(b) Permeability
Gravel
Sand
Vesicular basalt
Silt
Volcanic tuff
Limestone
Clay and shale
Igneous and metamorphic rock
10-9
10-7
10-5
10-3
10-1
101
103
105
K (meters/day)


Groundwater systems
Recharge
Recharge
Artesian well
Water table
Extension of water table
Depressed water table around well
Freshwater lens on saltwater
Spring
River
Vadose zone
Saltwater encroachment
Groundwater
Ocean
Seawater
Limestone
Confined sandstone aquifer
Impermeable shale
Impermeable basement rock
Basinal brine


Major aquifers
High Plains
Western Mexico
Persian
Arabian
Indus Delta
Upper Ganges
North China Plain
= Major groundwater aquifers
= Arsenic-affected aquifers
= High fluorine groundwater
0 Miles 3000
0 Kilometers 4000


Drainage area
Pleistocene lakes
Present day lakes
Interbasin divides
Drainage
Harney Lake
Malheur Lake
OREGON
Summer Lake
Albert Lake
Lake Alvord
IDAHO
Goose Lake
Lake Bonneville
Bear Lake
WASATCH RANGE
Lake Lahontan
Great Salt Lake
Honey Lake
NEVADA
Pyramid Lake
Utah Lake
Lake Tahoe
Carson Lake
Walker Lake
SIERRA
UTAH
Mono Lake
Lake Russell
Lake Kawich
NEVADA
Lake Manly
CALIFORNIA
ARIZONA
Lake Searles
Lake Mojave
Lake Manix
42°
40°
38°
36°
120°
118°
116°
114°
112°
0
100 MILES
0
100 KILOMETERS


no
pore spaces
unconnected
pore spaces
connected
pore spaces
non-porous
non-permeable
porous
non-permeable
porous
permeable

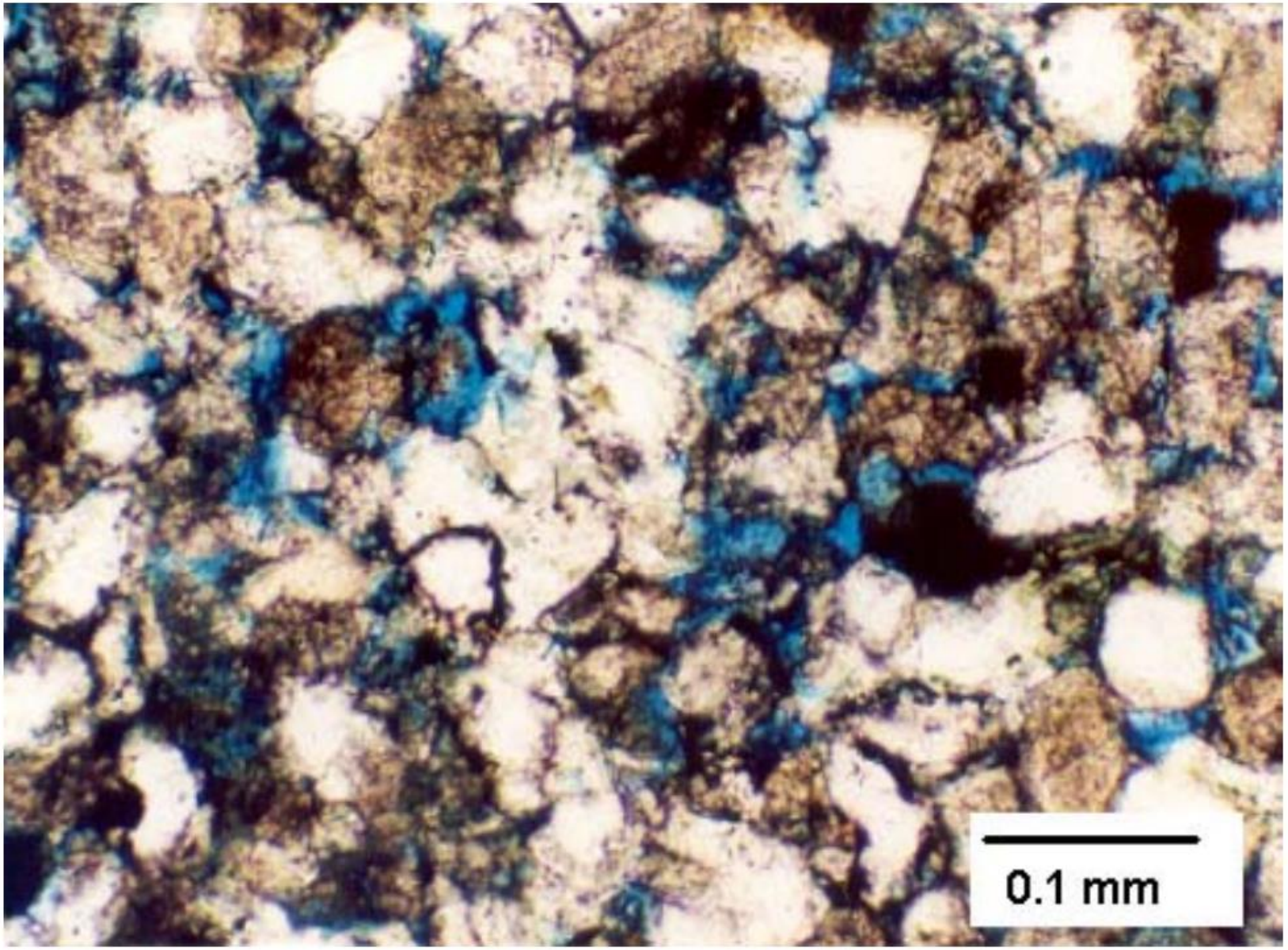
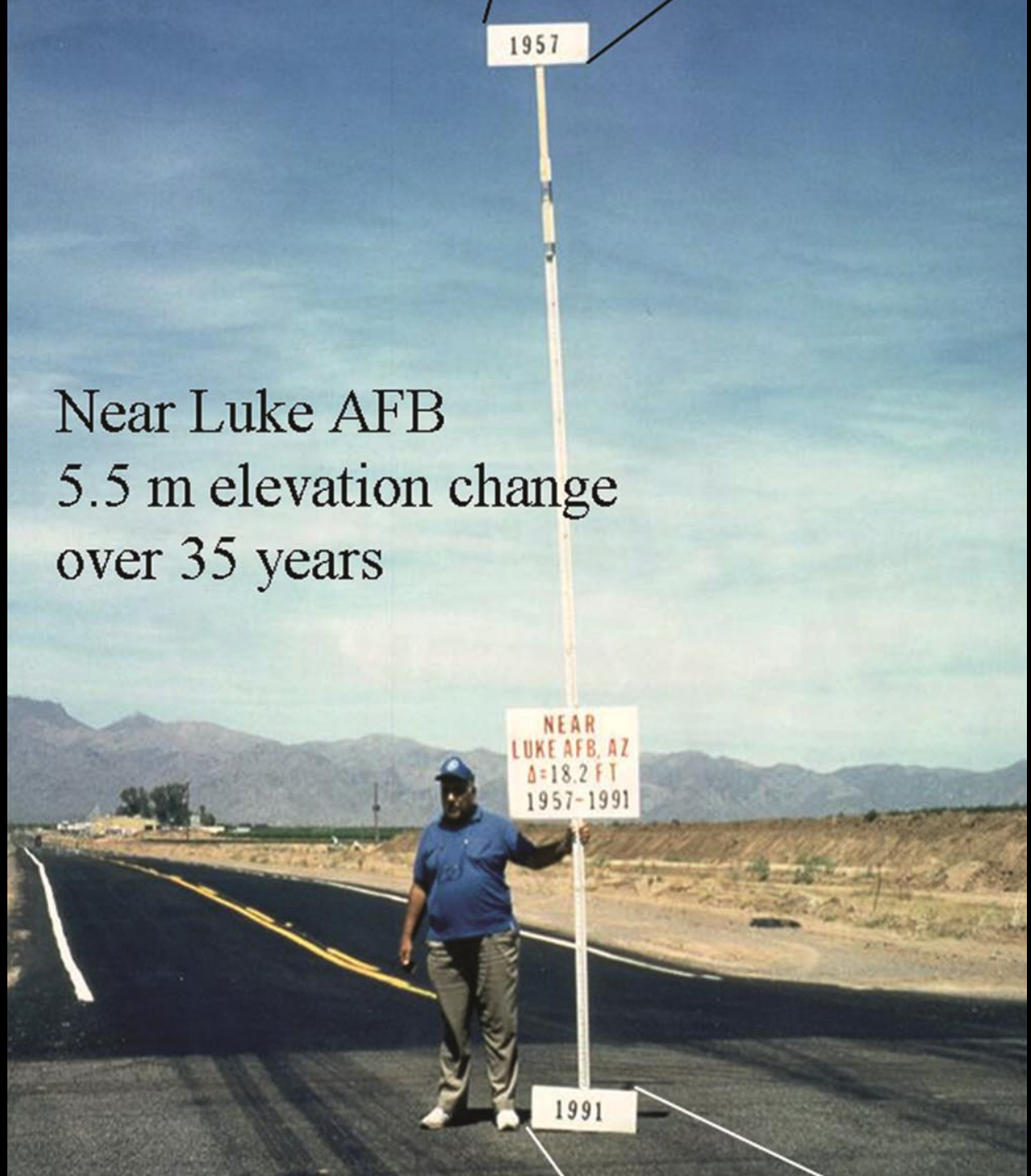
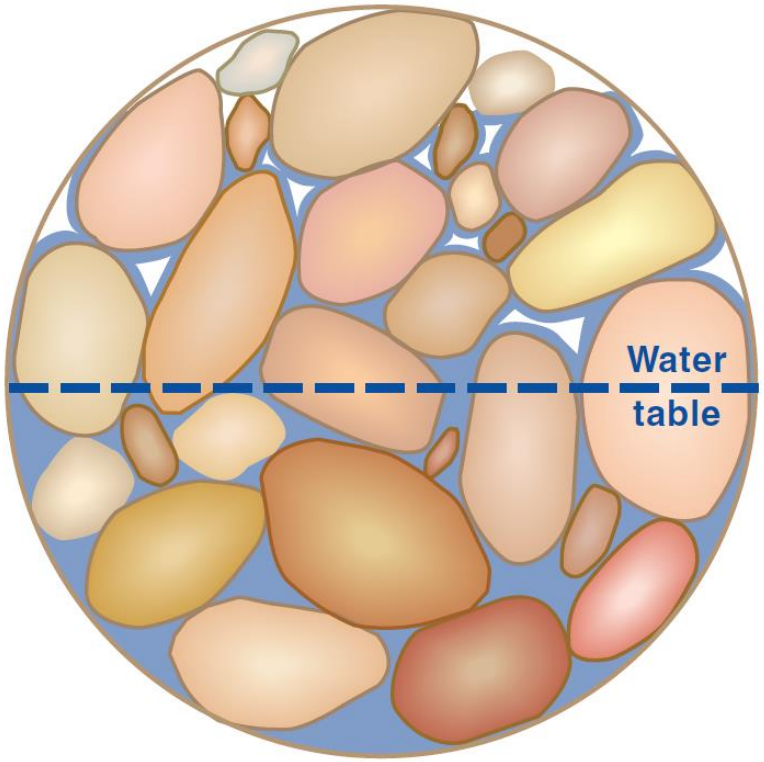
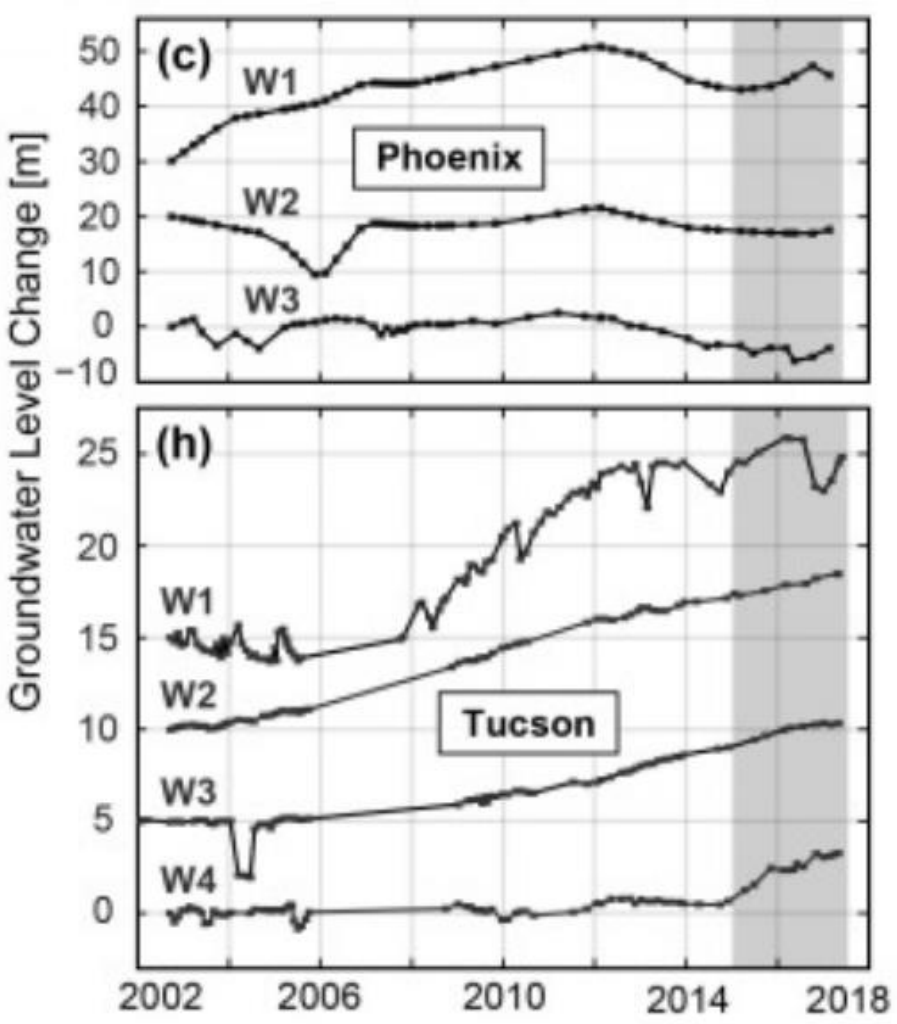


Figure 3. Greatly magnified microscopic image of a sandstone reservoir rock. The pore spaces may be occupied by oil, gas, or water. This is from the gas-productive sandstone of Figure 4. From Broadhead[1].


1957
Near Luke AFB
5.5 m elevation change
over 35 years
NEAR
LUKE AFB, AZ
Δ=18.2 FT
1957-1991
1991

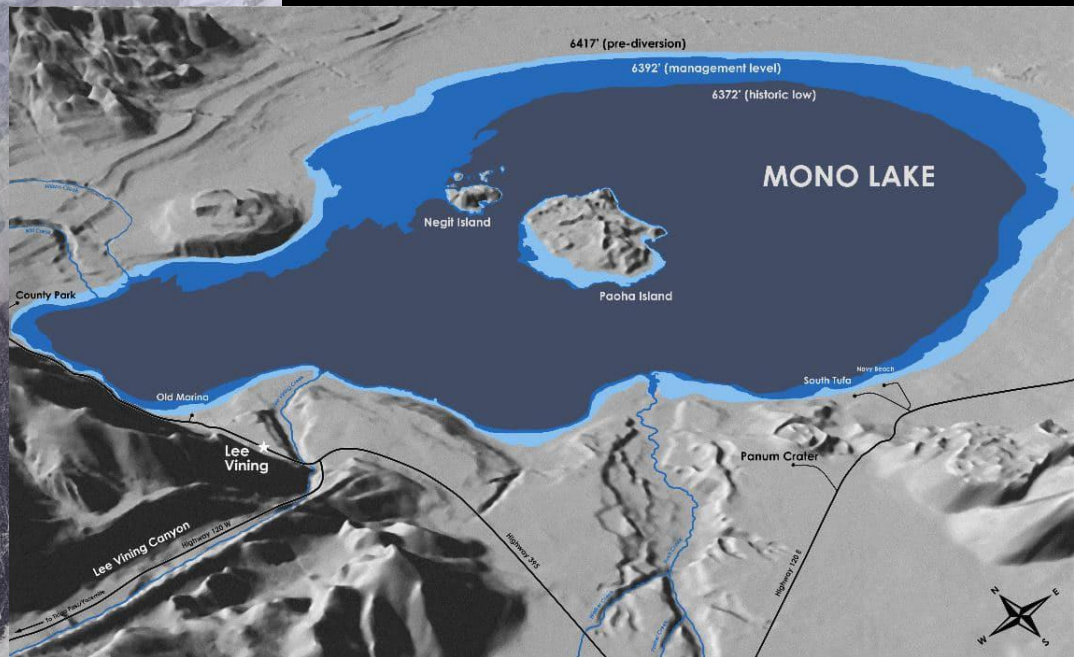




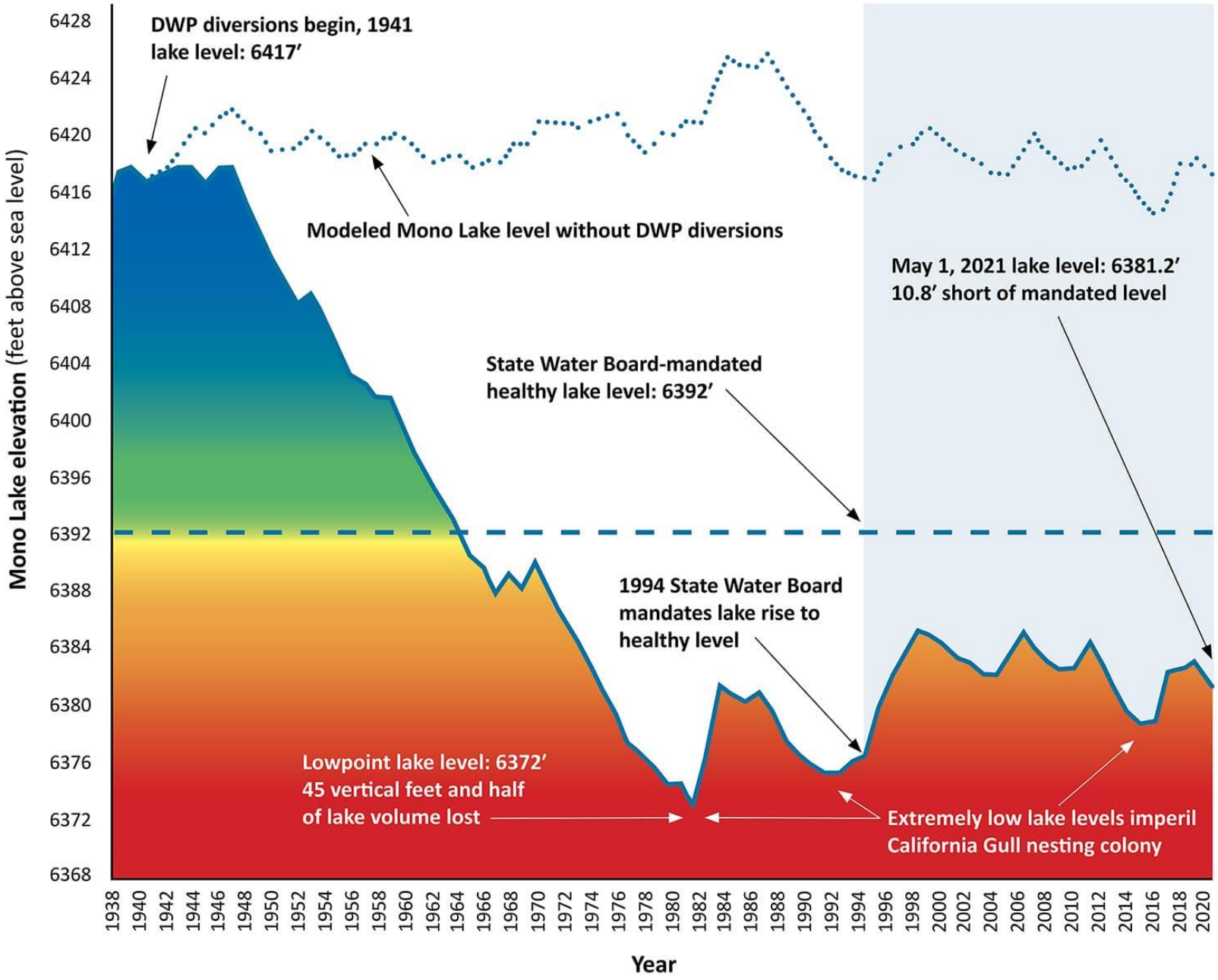
(Chandrakanta et al., Journal of Hydrology, 2020)


Lake Oroville
Sacramento
Mono Lake (Saline)
Los Angeles Aqueduct
California Aqueduct
Hoover Dam
Los Angeles
Local Groundwater
Colorado River Aqueduct
Colorado River

Mono Lake


6417' (pre-diversion)
6392' (management level)
6372' (historic low)
MONO LAKE
Negit Island
Paoha Island
County Park
Old Marina
South Tufa
Navy Beach
Panum Crater
Lee Vining
Lee Vining Canyon
Highway 120 W
Highway 395
Highway 120 E
N
E
S
W

Mono Lake surface elevation



This LADWP groundwater pump is one of many adjacent to the upper section of the LA Aqueduct south of the town of Independence. This area was a wetland meadow before the LADWP began pumping the groundwater into the LA Aqueduct in the early 1970s. Twenty years of litigation between Los Angeles and Inyo County eventually resulted in the 1991 Inyo-Los Angeles Long Term Water Agreement. This legal agreement has never been enforced effectively, and the LADWP continues to pump groundwater in excess of the Long Term Water Agreement's environmental protection goals.

Laying fabric and gravel over playa sediments to decrease airborn dust


WELL
WELL

Carlsbad is California's largest desalinization plant

Vocabulary:

- Aquifer
- Porosity and Permeability (in rocks)
- Land Subsidence
- Water Table