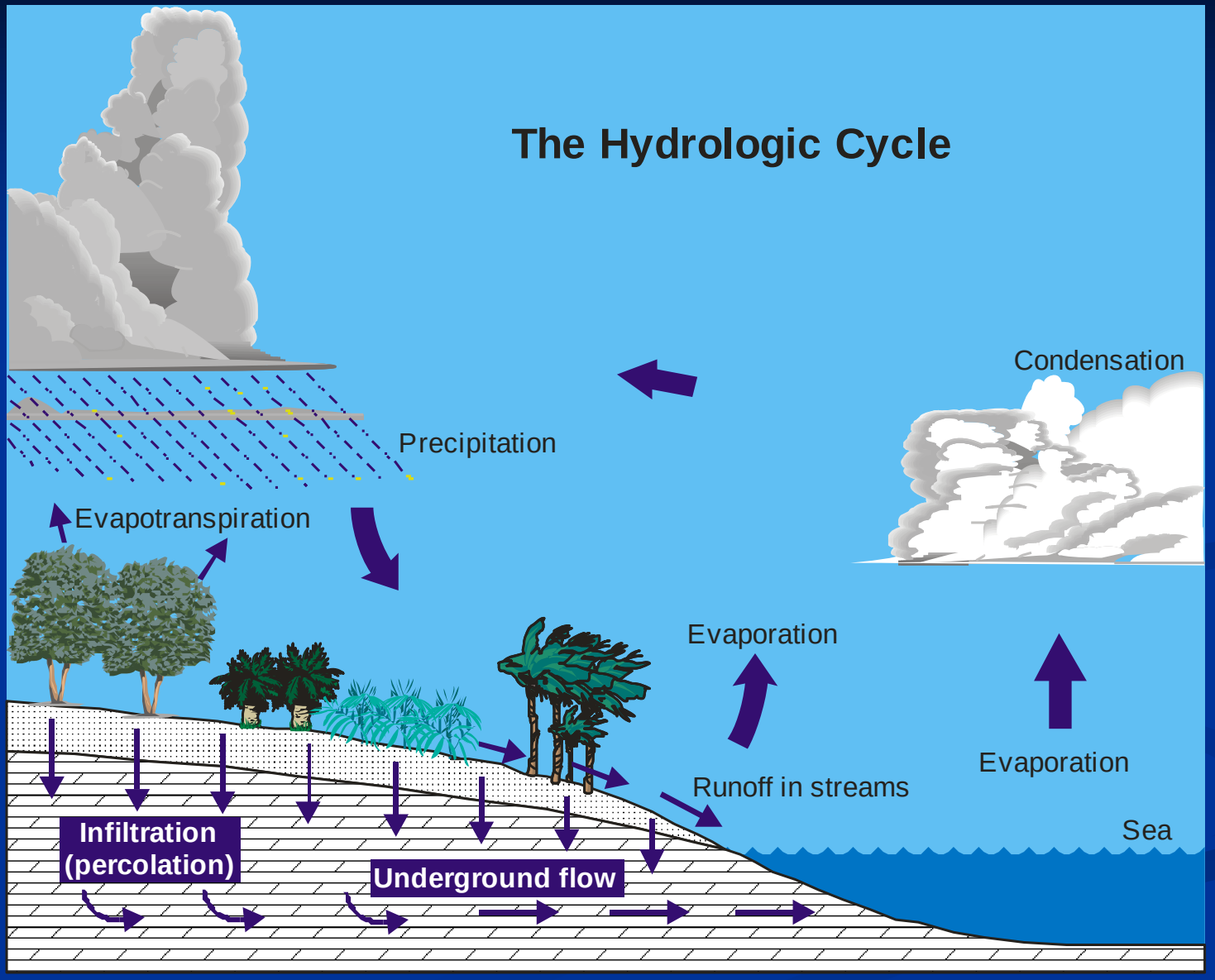
Hydrology of Guam

BI 201 Natural History of Guam

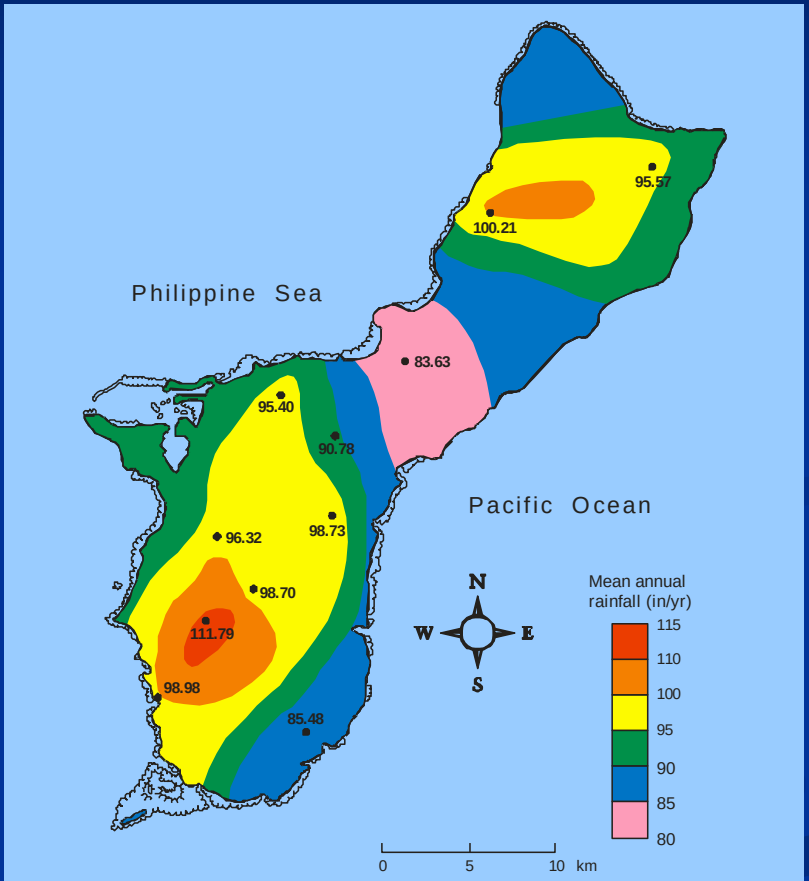
Class Presentation 19

- **Hydrology** is the study of the hydrologic cycle
  - The **hydrologic cycle** is the flow of water in its various states (i.e., solid, liquid and gas) through the terrestrial and atmospheric environments

- Water falling as precipitation may
  - **evaporate** back into the atmosphere
  - return to atmosphere by **evapotranspiration** [i.e., the loss of water from the soil by evaporation from the surface and by transpiration from the plants growing there]
  - **run off** the land into streams and rivers and flow to the sea
  - **infiltrate** (percolate) into the soil
  - **flow underground** to the sea

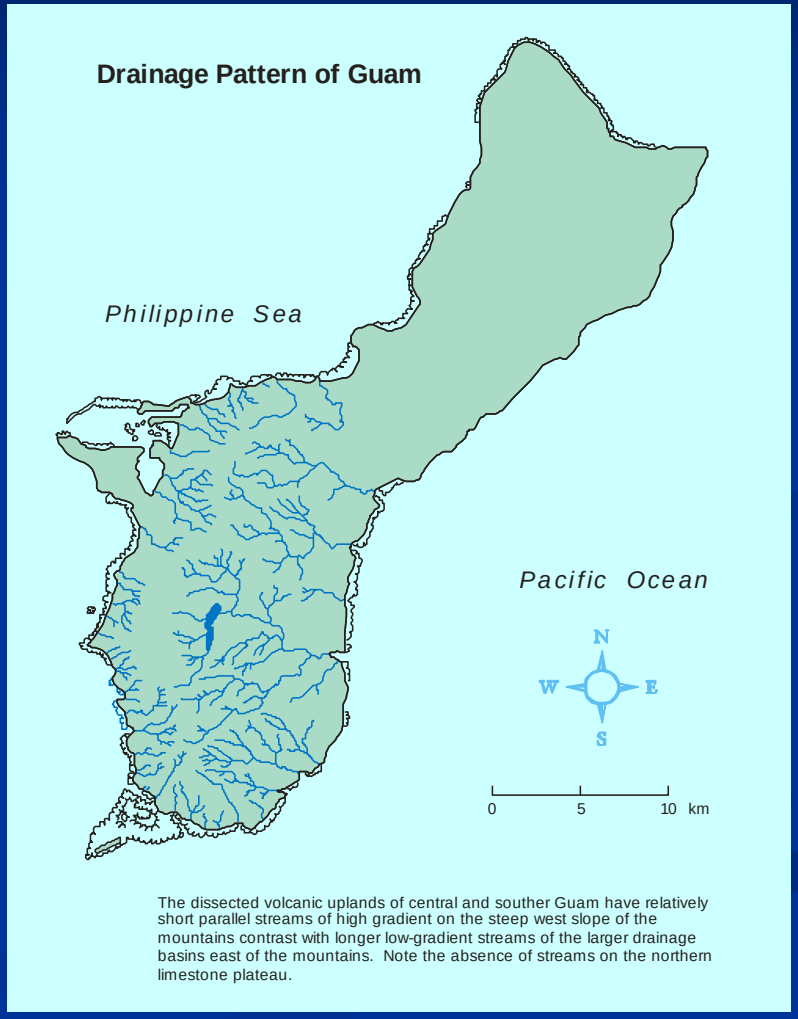

The Hydrologic Cycle
Condensation
Precipitation
Evapotranspiration
Evaporation
Evaporation
Runoff in streams
Sea
Infiltration
(percolation)
Underground flow

- The average rainfall on Guam is about 86 in/yr
  - Therefore, when the total area of the island is considered, we can calculate that Guam receives an average of about 1 billion gal/day
  - Of the total, about 500 million gal/day falls in southern Guam and about 500 million gal/day falls in northern Guam



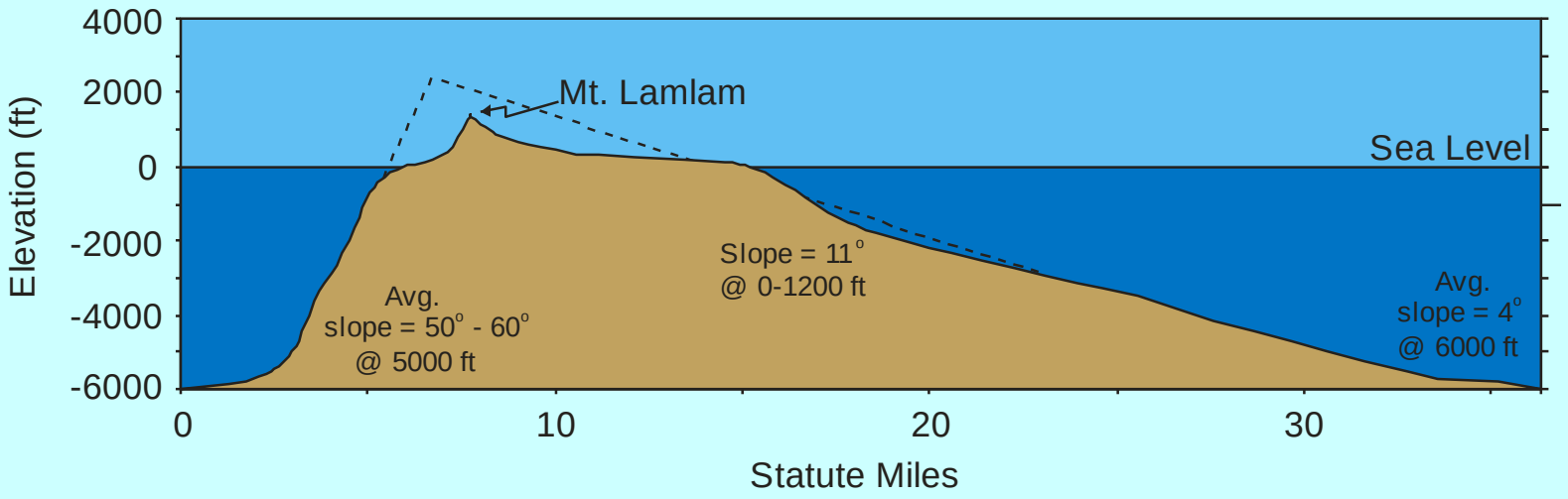
Mean annual rainfall on Guam, based on data provided by Tom Yoshida, U.S. National Weather Service.

- **Stream flow**
  - There are 33 rivers on Guam, all south of Adelup-Pago fault zone
  - About 250 million gal/day flows to the sea (i.e., about ½ the mean daily rainfall)
  - Most of this flows from the southern volcanic half of the island



The dissected volcanic uplands of central and souther Guam have relatively short parallel streams of high gradient on the steep west slope of the mountains contrast with longer low-gradient streams of the larger drainage basins east of the mountains. Note the absence of streams on the northern limestone plateau.

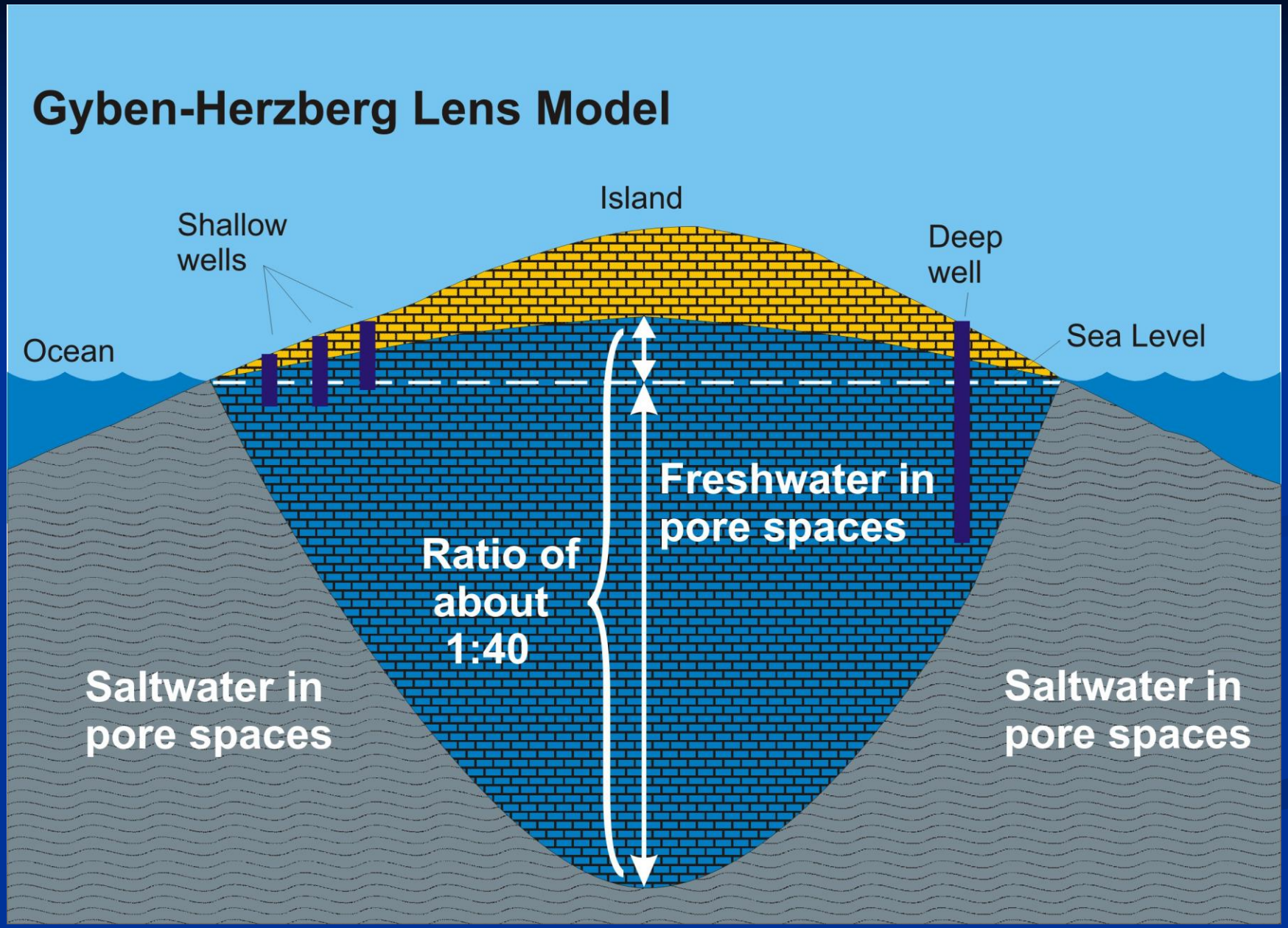
- Most of the runoff is from streams on the eastern slopes of the island
  - The gentler gradient on eastern slopes results in larger drainage basins and longer rivers
  - The western slopes have a much higher gradient and shorter rivers with smaller watersheds



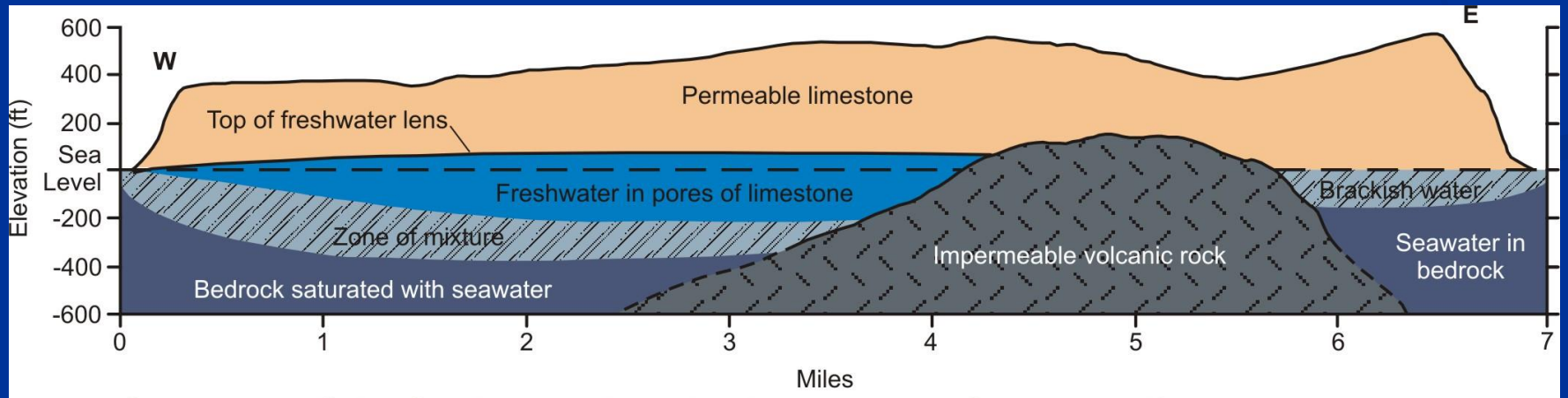
East-west profile through Mount Lamlam. Lower profile has vertical exaggerati x5; upper one has identical vertical and horizontal scales [Adapted from Emery, 1962].

- **Ground water**
  - Ground water in Guam is primarily located in the permeable limestone of the northern plateau
  - Very little ground water occurs in southern Guam because of the low permeability of volcanic rock and clay soils
  - The northern **aquifer** [i.e., a body of permeable rock that is capable of storing significant quantities of water] fits the **Gyben-Herzberg freshwater lens model**

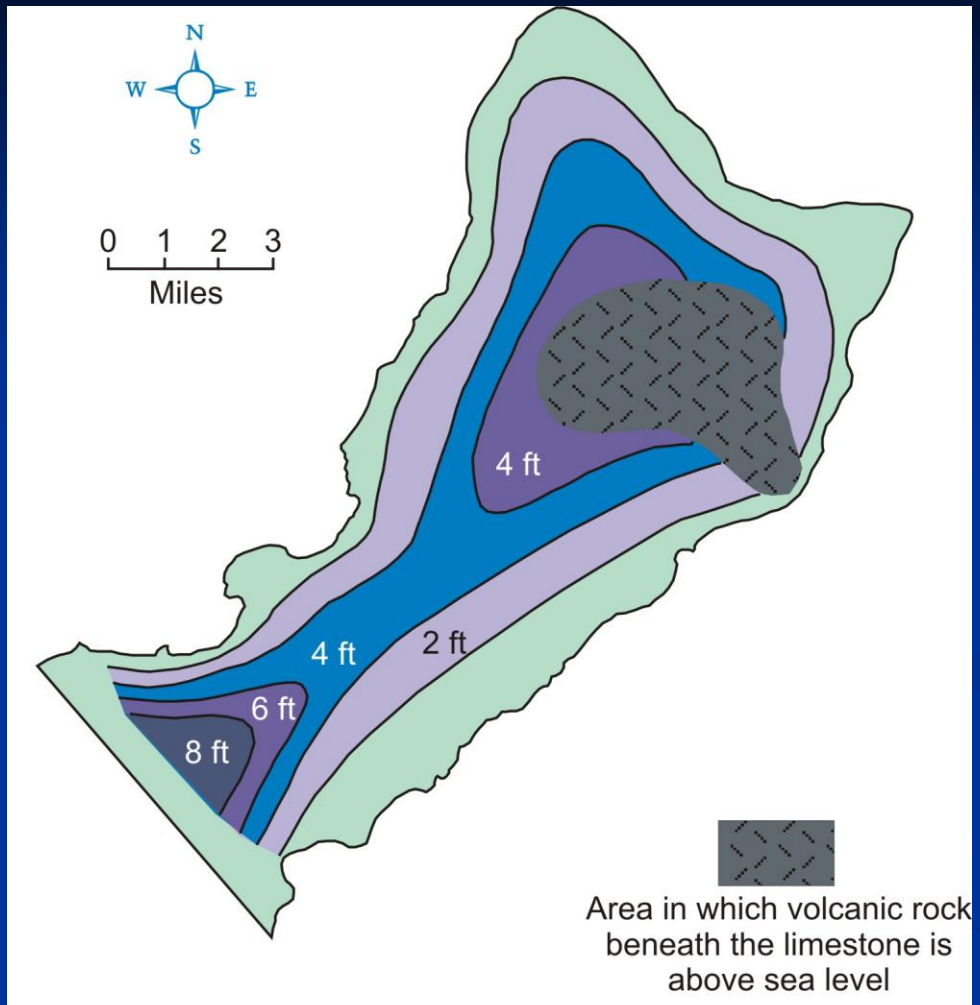
- The freshwater in the aquifer forms a roughly lens-shaped reservoir "floating" over seawater-saturated rock
- The model predicts that ***for each foot of freshwater above sea level, there are 40 feet of freshwater extending below sea level***


Gyben-Herzberg Lens Model
Island
Shallow wells
Deep well
Ocean
Sea Level
Freshwater in pore spaces
Ratio of about 1:40
Saltwater in pore spaces
Saltwater in pore spaces

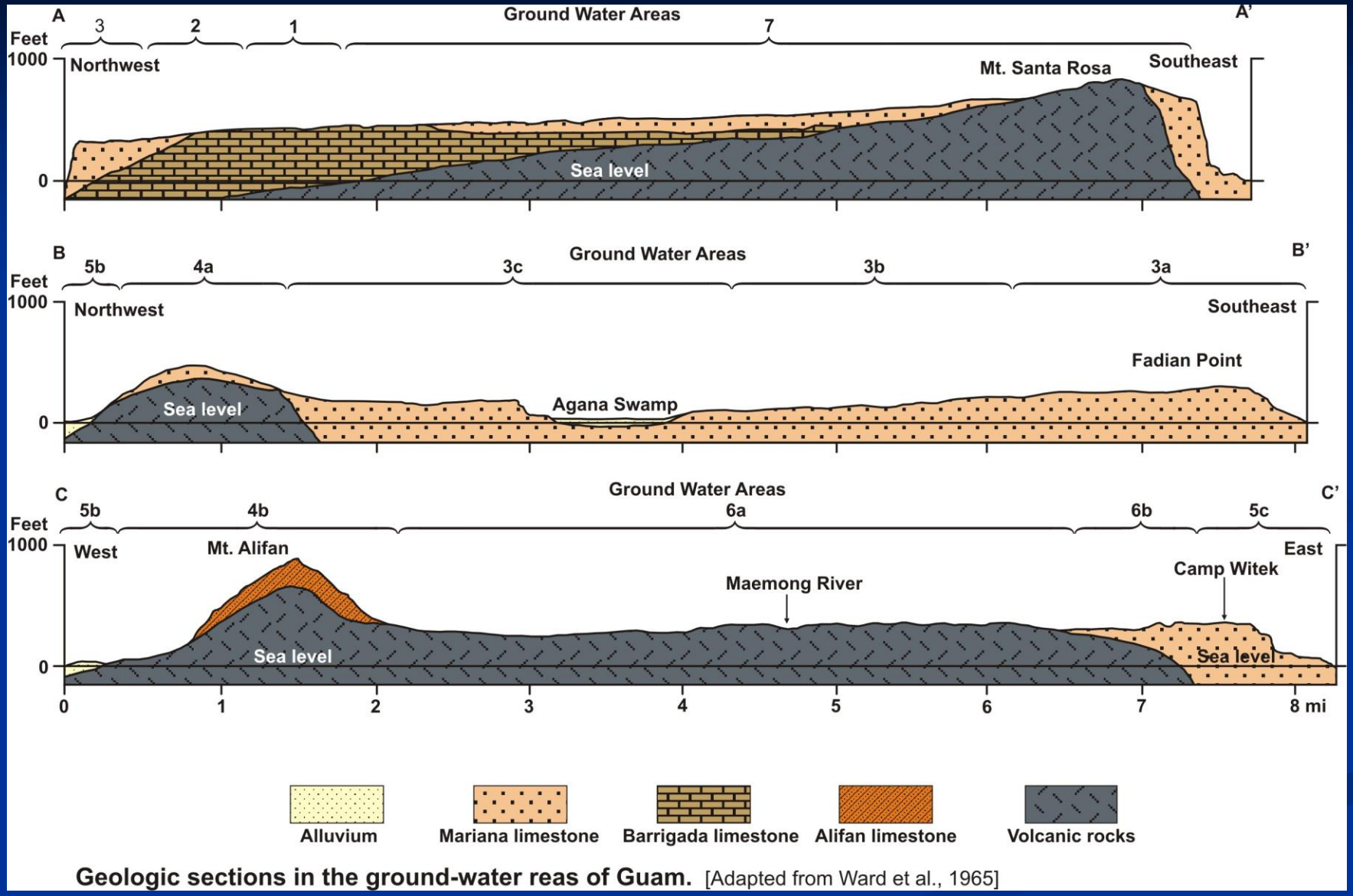
- Guam's aquifer is divided into six separate basins by impermeable volcanic basement rock near Mt. Santa Rosa



Structure of the freshwater lens in the northern Guam aquifer. [Adapted from Ward et al., 1965].



Guam lens contour in the northern Guam aquifer. Contour interval is 2 ft; datum is mean sea level. [Adapted from Ward et al. 1965].



Geologic sections in the ground-water reas of Guam. [Adapted from Ward et al., 1965]