

GLG 101 – CHAPTER 17 - GROUNDWATER

- Groundwater is the water that fills open spaces, or “pores” underground. It is the largest source of fresh water on Earth (other than glaciers in the polar caps).
- Beneath the Earth’s surface, there is initially a zone where pore spaces are not completely filled with water. This is called the **unsaturated zone** (also known as the zone of aeration or the vadose zone). Beneath this zone, all pore spaces are completely filled with water. This area is known as the **saturated zone** or the **zone of saturation**. The boundary between the unsaturated and saturated zones is called the **water table**.
- The amount of open space in rocks or sediments, into which water can flow, is known as the **porosity**. The “connectedness” of these pore spaces, determining how well water can flow through the rock or sediment layers, is known as **permeability**. A rock layer that is both porous and permeable, and from which a useful amount of water can be extracted, is known as an **aquifer**. A rock or sediment layer that allows little or no flow of water through it is known as an **aquitard**. Aquitards will have very low permeabilities.
- Aquifers can be either open (**unconfined**) or closed (**confined**). An unconfined aquifer will be a porous and permeable material in direct contact with the overlying land surface so that water can freely sink down to the water table. A confined aquifer will be sandwiched between aquitards, so that hydrostatic pressure can build up, leading to a rise of water above the top of the point at which a well is drilled into the aquifer. This is called an **artesian well**, or a **flowing artesian well** (if the water rises up above the ground surface to gush out).
- When the water table intersects the ground surface, **springs** result. Areas with abundant rainfall will have groundwater that feeds streams (water table intersects the surface at the streambed), so that they flow year-round and are called **perennial**. Dry climates will have water tables that are beneath the bottom of the streambeds, so that water soaks into the ground from the streams, and they flow only during wet/rainy times. These are known as **ephemeral** streams.
- In wet climates, limestone will get highly dissolved by groundwater, and **caves** and **karst** topography (from sinkholes that form by collapse into empty caves). The danger of sinkholes is greatly increased when man drops the water table and empties out these cave systems, removing the buoyancy force that helped hold up the cave roofs. Florida is an area where this geologic hazard is significant today.
- In other areas, excessive pumping of groundwater can lead to **ground subsidence**, or a dropping of the land surface, which can produce earth cracks and destroy buildings and roads. Arizona has experienced this in the past due to excessive pumping for irrigation of crops like cotton in the Phoenix and Casa Grande areas.