Ground Water

Ground Water- lies beneath the ground surfaces filling the pore space between grains in bodies of sediment and elastic sedimentary rock, and filling cracks and crevices in all types of rock>major economic resource, especially in dry western U.S.

Approximately 15% of the total precipitation ends up as groundwater (does vary from 1% - 20%).

Porosity- the percentage of rock or sediment that consists of voids or openings

>measurements of a rock's ability to hold water

>most rocks can hold water

>Table 11.1- compaction/cementation lowers porosity

Permeability- refers to the capacity of a rock to transmit a fluid through pores and fractures.

measures the relative ease of water flow and indicates the degree to which openings in a rock interconnect.

THE WATER TABLE

>Responding to the pull of gravity, water percolates down into the ground through the soil and through cracks and pores in the rock.

Water Table Zones Saturated Zone- subsurface zone in which all rock openings are filled with water.

Figure: Water Table- upper surface of saturated zone.

Vadose Zone- a generally unsaturated zone above the water table. >surface tension causes water to be held above the water table (the capillary fringe). >Plants like moisture and air space of vadose zone.

Perched Water Table-top of a body of ground water seperated from the main water table beneath it by a zone that is not saturated. Figure >typically on top of a shale layer

THE MOVEMENT OF GROUND WATER

In general, water moves in response to differences in water pressure and elevation.

Darcy's Law and Fluid Potential Hydraulic Head = elevation + pressure. Hydraulic Gradient = difference in head/distance=h/L

$$\label{eq:Law} \begin{split} Law = Velocity = (Perm/Porosity) \mbox{ (hydraulic gradient) } \\ V = K/n \mbox{ h/L} \end{split}$$

Fluid Potential = g x hydraulic head Figure Z- Black Lines (potential) –Blue = flow

Facts:

*The slope of a water table strongly influences groundwater- velocity.

>the steeper the slope, the faster the water moves.

*Velocity also depends on permeability of the rock.

>dye traces

Figure - Movement of GW

AQUIFERS

Aquifer- body of saturated rock or sediment through which water can move easily.

- \blacktriangleright To obtain the water must drill well- Fig. 17.4, 17.5
- Good aquifers: SS< conglomerate, well jointed Ls, sand and gravel, some fragmented or fractured crystalline rocks.

Aquitards- retard flow of water

Shale, most crystalline rock

Aquiclude-now flow at all

Unfractured crystalline rock

Figure > Confined vs. Unconfined Aquifers Filled with H₂O under P: Recharged by Precip. Rapidly Slow water movement:

WELLS

Well- deep hole designed to penetrate aquifer.

Addition of new water to saturated zone- Recharge

Cone of Depression- occurs when water is pumped from well. >Lowering of W.T.- Drawdown >Drawdown does not occur with light use.

Confined Aquifers can sometimes produce artesian condition (sometimes called Artesian Wells/AQ).

>water rises above the top of the aquifer Dakota SS (Figures)

Figure - along fractures, faults or rock contacts.

Factors Controlling Water Movement (aka springs)

- 1) Joints
- 2) Karst Bedrock (Limestone and other carbonates)
- 3) Facies Changes: change of one type of rock into another
- 4) Fault

Gaining streams- receive water from the saturated zone, during wet season. Figure

Losing Streams – lose water to saturated zone, during dry season.

CONTAMINATION OF GROUND WATER

Pollutants: Pesticides, herbicides, fertilizers (nitrate), heavy metals Figure- yuck Sewage (virus, bacteria, parasites) Cyanide, degreasers, acid mine drainage, radioactive waste Yucca Mtn.- 180 miles NW of Vegas Contaminants (cont.)

- 1) Less dense spread out (gas) Figure
- 2) More dense sink Figure

Not all contaminants are man-made.

Naturally occurring- As, Se, Hg.

Sometimes aquifers can purify themselves Sandy Loam vs. Fractured Rock Figure

Groundwater wells are difficult to clean up.

Pumping can contaminate (Figure)

Balancing Withdrawal and Recharge Sinking Cities- Houston, Mexico City (7m), San Joaquin Valley (9m) >subsidence can damage buildings.

EFFECTS of GROUNDWATER ACTION

Karst Topography: Caves, Sinkholes Figures

Other Effects: Petrification, Concretions, Geodes

Hot Springs- Warmer the human body T. -Geysers

Geothermal Energy.