HANDOUT: Go with the Flow - Permeability Demonstration

What influences the rate of water infiltration?

In nature, the ease of water to flow through soil (permeability) is impacted by the size of the soil particles and particle compaction.

Smaller particles tend to create small "throats" or passageways that connect the more open network of pores in a rock, making it more difficult for water to flow.

If the soil particles are less compact (Fig. 1), water can move more easily through the soil. However, if the soil is more compact (Fig. 2), water cannot move easily through the soil.

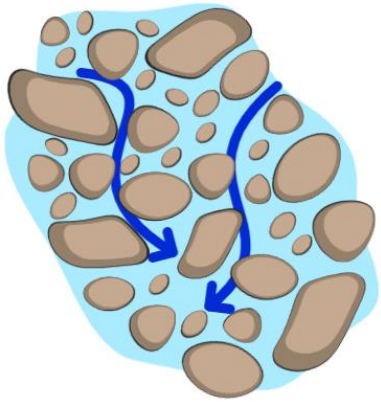

Fig. 1 Less compact soil allows water to move easily, therefore demonstrating high permeability.

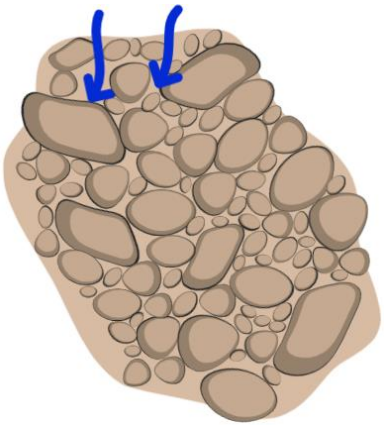

Fig. 2 More compact soil does not allow water to move easily, therefore demonstrating low permeability.

Source: Sabrina Ewald

Applications of Permeability in the Subsurface

We can directly observe the rate of permeability when it rains. Soil particles affect whether water collects on top of the surface and runs off (to the closest creek, and then off to a larger river and away from the area) or infiltrates into the subsurface. We can use this observation to better understand how oil and natural gas migrate through subsurface rock.

Soil is still much more permeable than rock (or any type of man-made pavement). As we go deeper under the surface, rock layers have a smaller and smaller ability to transport water (or any other fluids, such as oil and gas) through them. As water moves into the subsurface, it becomes trapped by these less permeable rock layers. The same is true for oil and gas as it migrates from source rock and becomes trapped in porous reservoir rock beneath an impermeable seal (e.g., shale or clay) (Fig. 3).

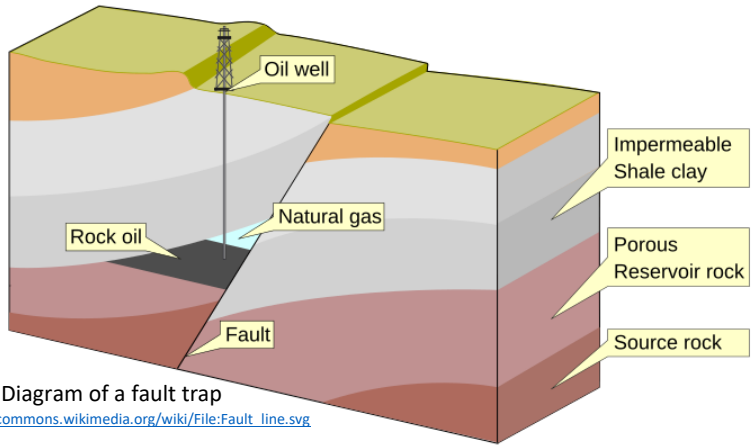

Fig. 3 Diagram of a fault trap

Source - https://commons.wikimedia.org/wiki/File:Fault_line.svg

During this activity, you will observe how permeability is influenced by the particle size.

Activity:

A. You will need 2 plastic syringes. Remove the stopper from each syringe, place a small mesh (cheese gauze works well) at the bottom, and fill each of the 2 syringes almost to the top: one with larger beads and the second with smaller beads. The syringes need to be secured in a stand (see photo) and place the stopper until you are ready to pour water.
B. Place a beaker beneath each plastic syringe to collect water.
C. Fill 2 more beakers each with 100ml of water.
D. Observe the beads and predict which beads you expect the water to move through most easily (fastest) and which you expect the water to move through less easily (slowest).
E. Ask two participants to help by removing the stoppers and pouring water from the beaker into the top of each syringe. Simultaneously, compare the time it takes water to move through the glass beads in the two syringes.