



# INTRODUCTION TO TERRESTRIAL HYDROGEOLOGY

Planetary and Terrestrial Mining  
Sciences Symposium

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# Objectives

1. Overview of the principles of groundwater flow
  2. Extension of these principles to the search for subsurface water
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- Stimulate discussion on where to look for usable quantities of water on the moon and Mars



# Groundwater Environments

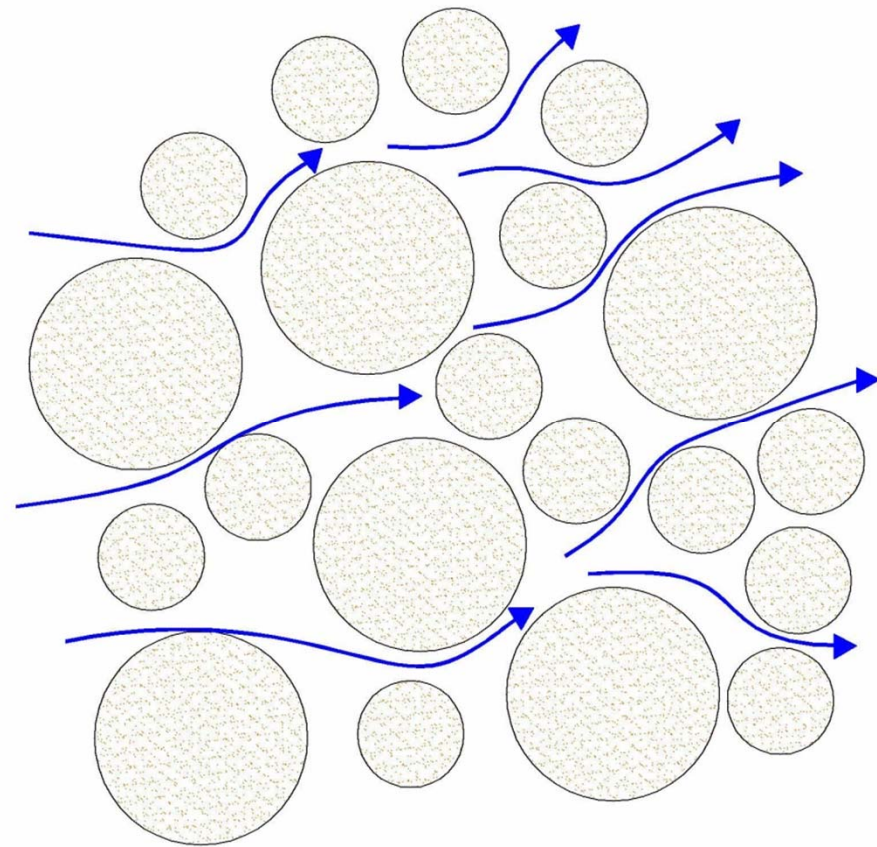
- Groundwater is present in all terrestrial environments





# Porosity – Unconsolidated

- In unconsolidated sediments, groundwater flows through void spaces between the individual grains
- Porosity can range from 0.25 to 0.70





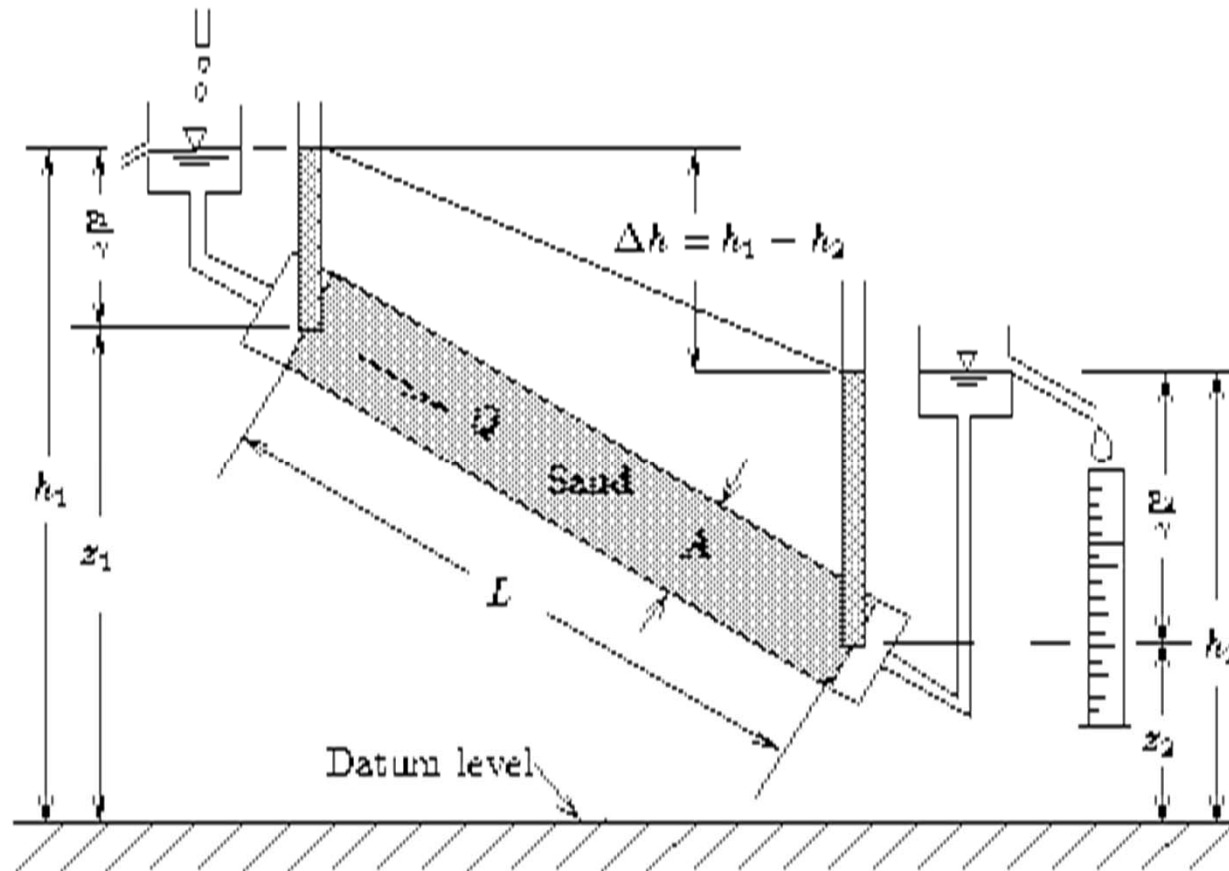
# Porosity - Consolidated

- Porosity in consolidated materials primarily due to fractures and dissolution cavities
- Porosity typically less than 0.01

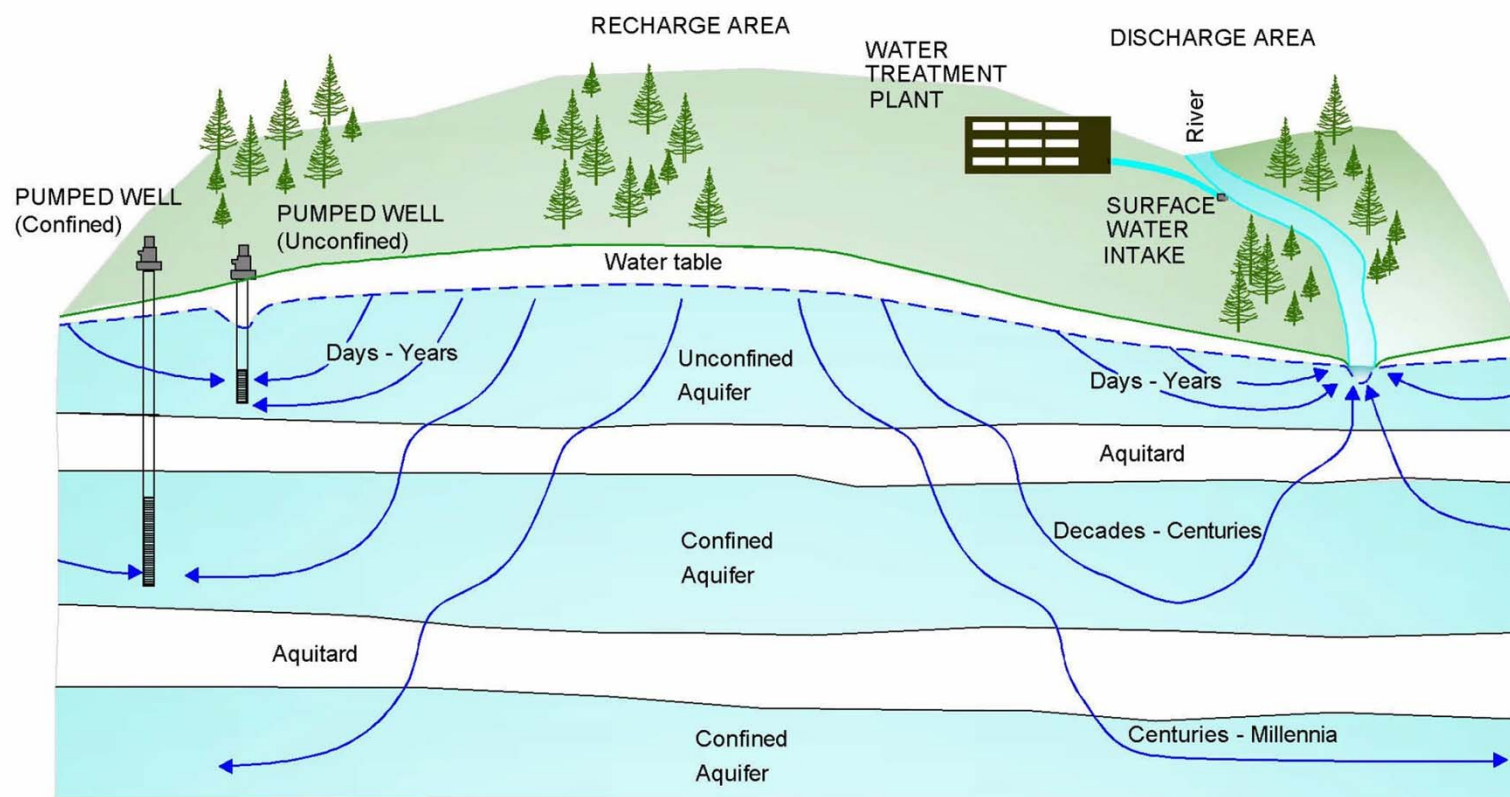




# Hydraulic Head and Conductivity



# Aquifers, Aquitards and Groundwater Flow





# Artesian Aquifers







# Equations

- Average linear groundwater velocity

$$v = \frac{Ki}{\theta}$$

- Volumetric groundwater flux

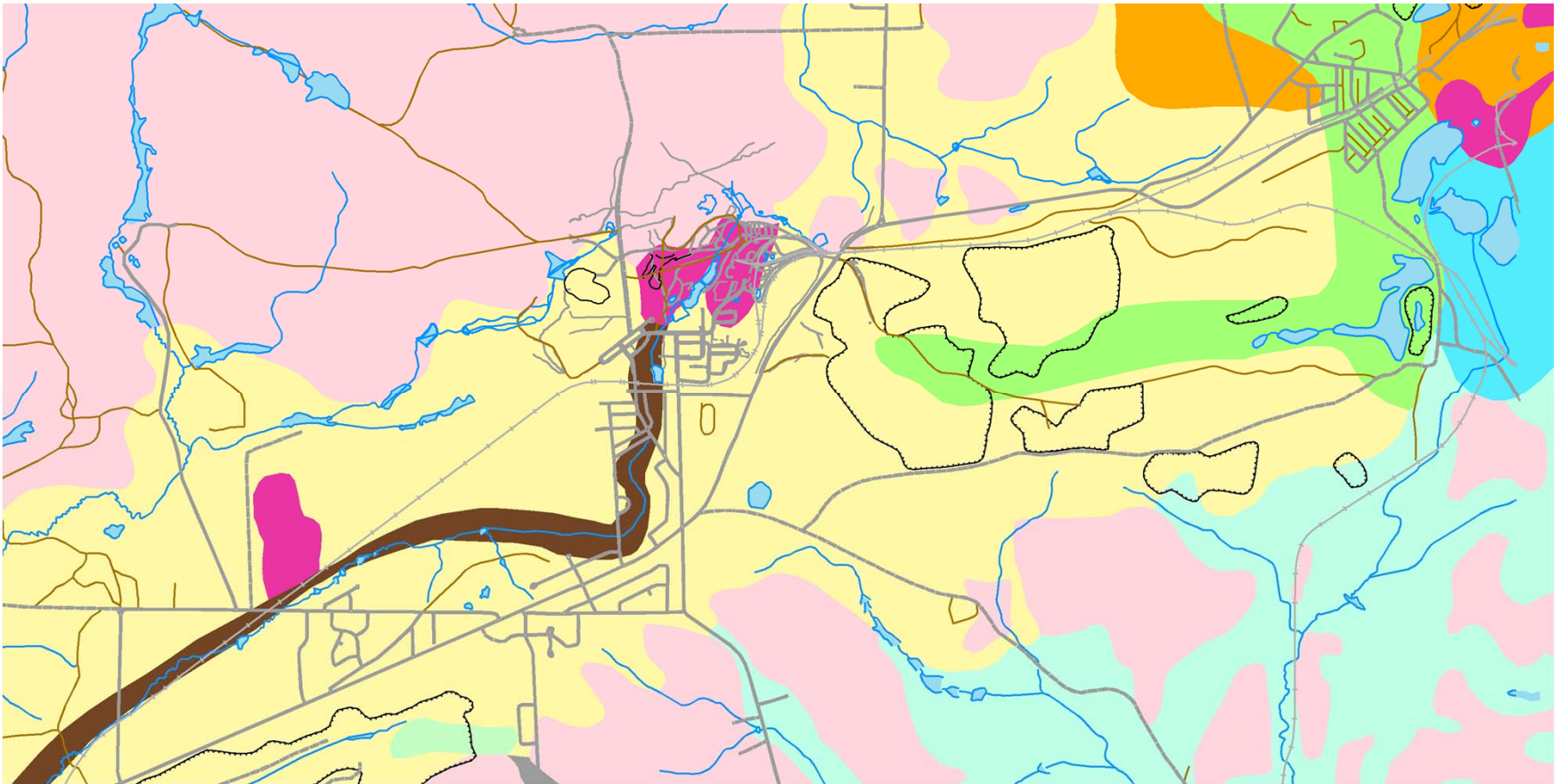
$$Q = KiA$$

# So, where do we find water?

- Coarse-grained materials transmit large quantities of water, but have low porosity
- Fine-grained materials transmit tiny quantities of water, but have high porosity



# How do we find water (Part 1)?





# How do we find water (Part 2)?

- Geophysical methods
  - Electrical resistivity
  - Time-domain electromagnetic
  - Frequency-domain electromagnetic
  - Ground penetrating radar
  - Seismic reflection
  - Seismic refraction
  - Neutron spectrometer







# Questions

