Sedimentation Lab

Background: Sedimentation is the process of deposition of a solid material from a state of suspension or solution in a fluid (usually air or water.) Broadly defined, it also includes deposits from glacial ice and those materials collected under the force of gravity alone, as in the accumulations of rock debris at the base of cliffs.

The physics of the most common sedimentation process, the settling of solid particles from fluids, has long been known. The settling velocity equation formulated in 1851 by Sir George Gabriel Stokes, is the starting point for any discussion of the sedimentation process. Stokes showed that the terminal settling velocity of spheres in a fluid was inversely proportional to the fluid's viscosity and directly proportional to the density difference of fluid and solid; the radius of the spheres involved; and the force of gravity. Stokes' equation is valid only for very small spheres (under 0.04 millimeters in diameter) and hence various modifications of Stokes' law have been proposed for non-spherical particles and particles of larger size.

Yet, this settling velocity equation does not provide a sufficient explanation of even the basic physical properties of natural sediments. The grain size of the elements and their sorting, shape, roundness, fabric and packing are the results of processes related not only to the density and viscosity of the fluid medium but also to the translational velocity of the depositing fluid; the turbulence resulting from this motion; and the roughness of the beds over which the material moves.

Stoke's Law: The force of viscosity on a small sphere moving through a viscous fluid is given by:

$$F_d = 6\pi\,\mu\,R\,V$$

where F_d is the frictional force – known as **Stokes' drag** – acting on the interface between the fluid and the particle; μ is the dynamic viscosity; R is the radius of the spherical object and V is the flow velocity relative to the object. In SI units, F_d is given in Newtons; μ in Pa·s; R in meters and V in m/s.

The CGS unit of kinematic viscosity was named "Stokes (St)" after his work.

Vocabulary

viscosity: the property of a fluid that resists the force tending to cause the fluid to flow

deposition: to lay or throw down by a natural process

******When doing the lab report write-up, be sure to follow the guidelines.******

Lab Activity – Part 1

How do sediments settle in a lake bed?

1. With your partner, predict the order in which the following sediments may settle out from a river from the first to the last.

Clay, silt, animal and plant remains, boulders, gravel, sand

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

2. Why do you think this will happen in the way you predicted?

_____
_____
_____
_____
_____
_____

3. Now obtain a sedimentator tube. Gently shake the sedimentator to loosen the sediments. Stand the sedimentator upright on one end and then flip it over so that it stands up on the other end. Observe the water and the sediments for a few minutes. Repeat at least once.

4. Draw what you see in pencil. Label each section with the type of sediment that is found at that level.

5. Look at your prediction from question 1 – do your predictions match your results? If there differences, how can you account for them?

_____
_____
_____
_____
_____
_____

6. Use the results of your experiment to complete the following chart. An entry has been done for you. You may choose to consult the Earth Science Reference Tables for assistance.

Sediment	**Particle Size**	**How formed?**	**Resulting Rock**
		(mechanical weathering, chemical weathering, plant decay, animal skeletons, etc...)	(choose from shale, coal, limestone, chalk, rock salt, conglomerate)
Boulder	Six (6) inches to many feet	mechanical weathering	conglomerate

Lab Activity – Part II

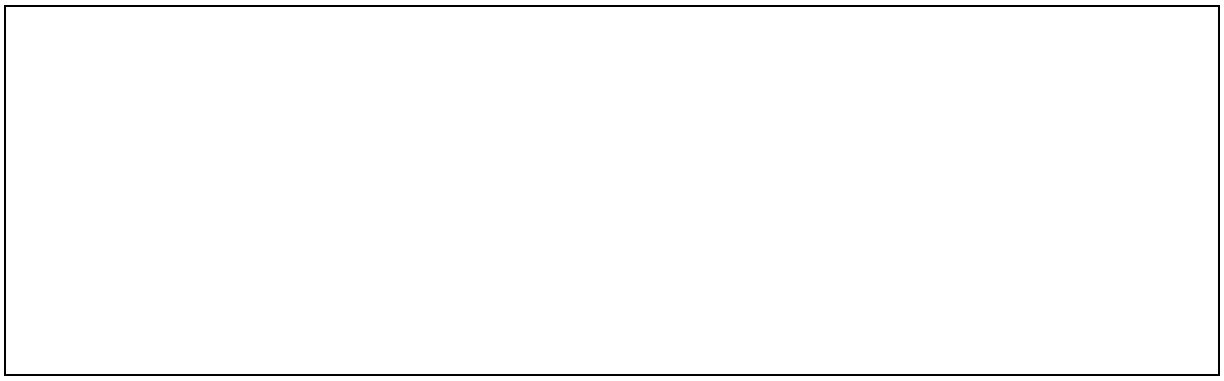
How do sediments settle on a river bed?

1. Gently shake the sedimentator tube to loosen the sediments. Lay it on its side.

2. Observe the water and the sediments close up at eye level for a few minutes. Repeat at least once.

3. Pick up the sedimentator tube and slightly tilt it up and down very slowly. Continue this motion as you observe the action of the moving water on the sediments.

4. Stop. Draw what you see in pencil. Label the sediments (boulders; gravel; sand; animal and plant remains; clay and silt.) Number each one according to which is deposited (1st, 2nd, 3rd and so on.)



River Mouth (estuary) ----------> Sea

Analysis and Conclusion Questions

1. Which sediments float in the moving water?
   _____
   _____
   _____

2. Which sediments move along the bottom?
   _____
   _____
   _____

3. Where would you expect to find the finest particles, towards the mouth of the river or out to sea? Why?
   _____
   _____
   _____