Topic: Effect of grain size and sorting on porosity

Objective: Students will learn how grain size and sorting can affect the porosity of rocks and thus how much fluids (petroleum, groundwater) they can store.

Materials Needed:

- 4 identical jars with lids
- Measuring cylinder (a thin one is preferred)
- Glass/plastic packing beads of 3 sizes (diameters 2 mm, 5 mm and 10 mm)
- Small funnel
- Small packing tool
- Marker pen
- Filter paper
- Strip of paper
- Glue

Activity Procedure/Steps:

1) Weigh a definite mass of packing beads (for example, 15 grams) from each of three packing bead sizes.
2) Fill three jars with packing beads of different sizes so that each jar contains only a single size of packing beads. Label the jars according to the diameter of the packing beads inside (A = 2 mm, B = 5 mm and C = 10 mm).
3) Fill the fourth jar with equal proportions of packing beads with all three sizes, mixing them. Make sure the mixture weighs the same as the beads in the other three jars (ex. 15 grams).
4) Label the jar with mixed-size beads as D.
5) Tightly pack the beads in each jar as much as possible using the small packing tool
6) Carefully add water up to the brim in all 4 jars, without letting plastic beads spill off of jar.
7) Carefully close lids in all 4 jars, making sure they are all up to the brim level.
8) Wet filter paper with water.
9) Place the funnel on top of measuring cylinder and put wet filter paper inside the funnel.
10) Glue a strip of paper along the measuring cylinder.
11) Empty the content of jar A onto the funnel, allowing water to fully drain into measuring cylinder.
12) On the strip of paper, use the marker pen to draw a line that indicates the maximum water level reached in the cylinder, annotating the jar label (“A) next to it.
13) Dispose the water in the cylinder and repeat the procedure (steps 11 and 12) with the other three jars. Remember to empty the water in the cylinder each time after you mark the level on the paper strip.

Expected results:

The water level drained out from jar A should be the highest while water level of jar D should be the lowest one. Second highest water level should be observed in jar C and third highest water level should be observed in jar B.

Conclusion and Remarks:

The different sized packing beads mimic different grain sizes available in nature. By packing them into a jar we are preparing an artificial reservoir rock. The water we are filling equates to fluids (petroleum/groundwater) which accommodate within porous spaces of the reservoir rock. Porosity plays a major role in determining the quantity of fluid a reservoir rock can hold (this is referred to as “reservoir quality”). This activity makes it easier to gain an idea that when grain sizes change, it affects for the porosity, and as porosity varies, the volume of water stored varies as well. The grain size distribution (or sorting) also affects the porosity because, when we have different fractions, the smaller grain sizes fill the gaps between the larger ones, thus clogging the pores.