Geo structures

Activity

In this activity, you will learn how fluids and gases move underground. You will construct the geological structures that hold resources and test how oil and water may be interacting kilometres beneath our feet. Check out the video for further instructions on how to conduct the experiment.

The Science

The Earth's crust is made up of a series of thick slabs, known as plates. As these plates move, rocks can be pushed together, pulled apart, or slide horizontally past each other. Some rocks that are ductile and bend in response to these stresses and produce folds. Some are brittle and break or fracture resulting in faults. These processes produce geological structures that can store resources like oil, gas and water underground.

These resources are typically found within reservoir rocks. Reservoir rocks, such as sandstones and limestones, store fluids and gases within holes known as pore spaces. These can be small gaps between individual grains or cracks that may form under pressure. If these pore spaces are well connected, the resources are free to move through the rock, which is known as permeability. As fluids and gases are typically lighter or less dense than the surrounding rocks, they migrate upwards towards the Earth's surface. Therefore, to keep the resources stored underground, a reservoir rock needs a seal. A seal is an impermeable rock, such as mudstone, above the reservoir that traps the resource in place and stops them from moving out of the reservoir.

However, it is clear the production and usage of fossil fuels like oil and gas have harmful impacts on the environment, such as through car emissions, ground water contamination and oil spills. In a hope to tackle human impact on global warming, scientists have discovered you can capture atmospheric carbon dioxide (CO_2) and store it underground. If buried deep enough, CO_2 becomes liquid and may behave in a similar way to oil and gas. This means that we can use old oil and gas reservoirs to store the excess CO_2 that we see in our atmosphere!

Materials

- Playdough – four colours will do (we used ~ 225 g per colour) the more playdough you have, the better the results!
- Small table knife
- Three cups or glass beaker (60 ml preferred)
- Food colouring – two or three colours
- One bowl or shallow dish for oil
- Small glass or transparent container
- Oil – any kind of cooking oil will do
- Water
- Plastic pipettes – one for each food colouring (optional)

Activity instructions

Part 1 – Creating geological structures out of playdough

1. Roll each colour of playdough into a sausage shape and split each equally into 3 parts.
2. Create your rock layers by pressing and stacking your playdough into 3 blocks of thin coloured layers up to 1 cm thick and more than 5 cm wide.
3. Identify which layer represents your reservoir and which represents your seal. Remember, the seal needs to be above the reservoir.
4. Using your hands, apply equal pressure either side of the first block causing it to deform into a wavy structure, known in geology as a fold.
5. Trim the edges off the front and sides by approximately 1 cm.
6. Repeat step 3 twice more using the other blocks but changing the way they are deformed (steps 6 and 7).
7. Push the second block together but apply more pressure from one side so that the fold is asymmetrical.
8. Use a plastic knife to cut through the third block at an angle. Slide one side up or down the other and push together.

You should be left with three geological structures capable of storing resources underground!

Part 2, look at how different types of fluids interact inside of these reservoirs

1. Pour the oil into the bowl/shallow dish so that there is a layer 1-2 cm thick.
2. Pour water into the glass.
3. Use the cups to combine 3-5 drops of food colouring with a splash of water and mix. One colour per cup.
4. Use the pipettes to squirt, or really gently pour, small drops of the food colouring mix into the bowl of oil. Do they mix?
5. In one swift motion, pour the bowl of oil into the glass of water. Watch how they separate. As the oil is less dense than the water, it rises to the top and the food colouring slowly drops to the bottom. As CO_2 is less dense than the surrounding geology, it should behave in a similar way to the oil when we inject it into the ground.
6. Finally, using our results from part 2 try and identify in the three geological structures (part 1), where you think fluids and gases like oil and CO_2 would move and accumulate. Sketching the structures you see may help!

Further investigation

Have you tried changing the texture of the playdough? Dry it out, add some sand or add some water to it. Give it a go and watch how the rock layers behave under the different pressures. If the playdough is drier it is more likely to break and fracture, whereas, if you add water the playdough may bend and produce different types of folds.