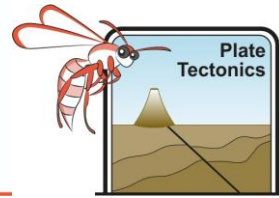


Geothermal Stimulation & Porosity – Teacher Notes



We can get heat energy from underground by tapping into natural hot water that lies within rocks below us or by introducing cold water into hot rocks and returning it to the surface to drive turbines that produce energy. To access the geothermal (geo = Earth, thermal = heat) heat in solid rock, water must be able to penetrate deep into the rock.

Similarly, to access oil and gas from reservoirs underground, the rocks must have pores or fractures which are joined to permit the hydrocarbons to move into the drill hole and be recovered.

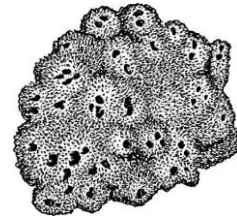
<http://www.geomore.com/porosity-and-permeability-2/>

Porosity and permeability

Students should have encountered the terms *porous* and *permeable* in Earth Science in years 7 & 8.

Common student misconception

Many students believe that water and hydrocarbons lie in reservoirs which are fluid bodies sitting in enormous cavities underground. This is not so. The reservoirs are all the pores lying within rock joined together in a similar fashion to which water is retained within a sponge. Water and hydrocarbons can flow through the pores within the rock.



A *porous* rock has spaces between its grains. Sandstone and pumice are porous rocks.

A *permeable* rock has spaces that are joined up permitting movement of fluid and gas within the rock. Sandstone is permeable and makes a good reservoir for oil, gas and water. Pumice is not permeable as pores are not inter-connected.

An *impermeable* rock has no pores and can only be permeable if it has fractures. Granite and basalt are impermeable.

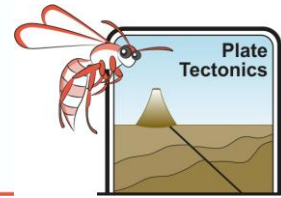
Teacher demonstration or student activity

Food cannot be eaten in a science room so this activity may have to be done elsewhere. This can be a memorable reward activity for good students. It is possible to buy packs of small Tim Tams and Aeros in supermarkets. Larger blocks can be cut with a knife.



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Geothermal Stimulation & Porosity – Teacher Notes



The picture below is of sections through the biscuit and bar. Pores/spaces can be discerned in both but they are only joined in the Tim Tam.

What is meant by the porosity of a rock?

A porous rock has spaces between clasts or fractures within in it

Name a porous rock.

Sandstone, pumice, sandy limestone, siltstone (poor porosity)

What is meant by a permeable rock?

A rock where the pores or fractures are joined permitting liquids and gasses to pass through

Name a rock that is both porous and permeable.

Sandstone, sandy limestone

Why do you think that there is a picture of Tim Tams and an Aero bar above. (They will be asked this question again at the end of the activity).

Both show pores but the pores in the Aero are not connected. If we want to get hot water for geothermal power or hydrocarbons from underground, the rock must be permeable.

Materials

- One Aero chocolate bar
- One Tim Tam biscuit
- Milk or water in a glass



Tim Tam section above and Aero section below

Method

Tim Tam

Bite the ends (or opposing corners) from a Tim Tam. Hold it between your lips and suck air in. Does the Tim Tam let air (gas) pass through? **Yes**

Attempt to suck milk through it. (Use the Tim Tam as a straw). Does the liquid move through? **Yes**

Aero

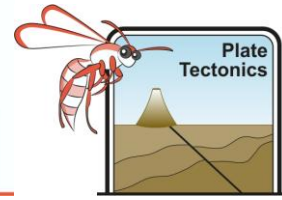
Bite the ends off an Aero bar. Hold it between your lips and try to suck air in. Does the Aero let air (gas) pass through? **No**

Attempt to suck milk from the glass through the Aero. Does the liquid move through the bar? **No**. Aero chocolate bars are full of large holes but the holes do not join up to permit movement within the bar. Aero bars are porous but not permeable

Which is porous, a Tim Tam or an Aero? **Both have holes and are porous**

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Geothermal Stimulation & Porosity – Teacher Notes



Which is permeable, a Tim Tam or an Aero? **Only the Tim Tam will permit liquids or gasses to travel through? Only the Tim Tam is permeable.**

If you left a piece of Aero and a piece of Tim Tam in a glass of milk, which would soak up the most milk. Explain your answer. **The Tim Tam would soak up most milk because its permeability would allow milk to soak through the whole biscuit. The aero would not allow penetration of milk.**

Porosity and permeability are important to permit the movement of hydrocarbons (oil & gas) to reservoirs and the formation of groundwater reservoirs within rock. Revisit the first question and see if you can write a better answer using more technical language.

Porosity, permeability, rock, reservoir, liquid & gas.

Most of Western Australia's conventional oil and gas reservoirs are in permeable rocks such as sandstone. Since they are already under pressure from the mass of rock above they will rise to the surface if penetrated by a drill hole. Our much larger "tight" oil and gas supplies need stimulation or fracking. This is covered in "Stimulation/fracking activity" in this section