Solid mantle in full flow: the DIY potty putty simulation

Learning objectives:

- where **tectonic plates** collide one is taken down into the **mantle** and 'destroyed'; where they move apart, new **lithosphere** is created.

Timing: around 5 minutes if you know what you are doing! Those unfamiliar with the experiment often need several attempts to get a successful outcome.

Health and safety: Sodium tetraborate (borax) is harmful if ingested in quantity and the dust may be irritating to the eyes.

Introduction:

Pupils frequently assume that the Earth's **mantle** must be liquid, firstly because they see liquid (**lava**) emerging from volcanoes and secondly because the idea that **tectonic plates** move implies **convection currents** in a liquid. In fact the mantle is almost entirely solid but the forces on it allow it to flow, much as the force of gravity can cause 'potty putty', which is solid, to flow.

Apparatus:

- 20 cm^3 PVA glue (not a rubberized variety from DIY shops, a simple glue as often used in school art rooms).
- A few cubic centimetres of dilute sodium tetraborate solution (borax) (approximately 25 g dm^{-3}).
- A small beaker or other container in which to mix the potty putty.

Method:

Add drops of the borax solution to the PVA glue in a small container and mix vigorously. When the polymer begins to crosslink (becomes less liquid and comes away from the sides of the container) it may be rolled between the hands to ensure complete mixing of the borax solution. If it remains sticky, then it has to be kneaded more vigorously. If it still remains sticky add a little more borax solution.

When left on the desk the potty putty will sink and spread.

However it will also bounce like a ball if enough borax is used.

It can be stretched far more than Plasticine™ if pulled gently, but can also be fractured if pulled suddenly.

Hints:

The trick is to mix the borax solution into the PVA well, rather than to add lots of it. Adding too much will result in a hard material that will not stretch.

If the mixture remains sticky, more borax solution is required.

You are recommended to try this in advance so that you can see when the mix starts to 'go'.

Often the potty putty improves if left for 20 minutes on a surface.

It will dry out eventually so to keep a good sample, keep it in a sealed plastic bag.

A few drops of food colouring can be added to make the final product more interesting. However adding too much will dilute your mixture and make it more difficult to make into potty putty. Also handling the coloured potty putty will result in food colouring staining the hands. This will wash off eventually, but not very easily!